



NSW 46 Class Electric Locomotive 4615



4615 at Eveleigh on 14th December 2002 after SETS Airport Colliery Tour. Photograph by Hugh Burns.

Summary

Built by Metropolitan-Vickers & Beyer-Peacock in Britain for the NSW Government Railways, electric locomotive 4615 was landed in Sydney on 15th November 1956 and entered service on 21st January 1957. It had an operational life of nearly 39 years before retirement on 17th January 1996. It was sold for preservation on 20th April 1998, and is in operational condition.

About 4615

The "46 class" electric locomotives were ordered and designed for the electrification of the Sydney to Wallerawang route over the Blue Mountains in N.S.W. The motivation was an expected increase in the volume of coal to be shipped from the western coalfields beyond Lithgow, in the mid to late 1950s. This extra traffic would make the capacity of the then existing steam hauled double track Western Railway line inadequate. Electrification was determined to be the most cost effective method of increasing the capacity of this line. However the coal traffic estimates proved to be over optimistic and this, together with the location of a large existing steam locomotive depot at Lithgow, resulted in the electrification project being terminated at Bowenfels - on the outskirts of Lithgow.

As a result of design experience gained with prototype electric locomotive 4501, the Mechanical Branch of the NSW Government Railways called tenders for the supply of 40 electric locomotives. British firm Metropolitan-Vickers was the successful tenderer and the first of the class entered service during June 1956, twelve months before completion of electrification to Bowenfels.

The 46 class locomotives were constructed by Metropolitan-Vickers Beyer-Peacock at Stockton in Britain, with electrical equipment made in Manchester and Sheffield. The 40 members arrived in Sydney, assembled, between May 1956 and February 1958. As electrification progressed across the Blue Mountains from Emu Plains, the 46 class began assisting steam-hauled trains in progressive stages until total electrification to Lithgow and Bowenfels was achieved on 9 June 1957, allowing the withdrawal of steam operations over the mountains.



A brand new 4615 sits on Wharf 7 at Pyrmont in November 1956. 4614 is in the air behind, being lifted by the floating crane "Titan", partially visible on the left. Photograph by Noel Reed.

On 15 November 1956, locomotive 4615 (builder's number 800) was landed in Sydney on the ship Jason, along with sister locomotive 4614. Due to a temporary surplus of electric motive power, it was not until 21 January 1957 that 4615 entered service. One of 4615's first duties was in forming, with 4606 and 4613, the official test train for the newly completed overhead section from Valley Heights to Katoomba.

On delivery 4615 was painted in "Midland Red" (maroon) livery, relieved by the application of crimson bands around the bodywork. Along with its siblings, 4615 was initially based and maintained at Flemington Electric Train Car Sidings, until the opening in May 1958 of the purpose-built diesel and electric depot at Enfield, known as "Delec". 4615 received a new colour scheme of Tuscan red body lined with yellow stripes in April 1968. The majority of the class received the so-called "candy" colour scheme, first introduced in 1982, including 4615. A hand full of the 46 class received the 1992 Freightrail Blue livery, again including 4615, which was one of the last to be done.

Brief details of the N.S.W. "46 class" electric locomotives are as follows:-

- Voltage: 1500 D.C.
- Gauge: 4' 8½"
- Wheel arrangement: Co+Co
- Weight: 111 tons
- Axle load: 18.5 tons
- Length over buffers: 54 feet (16.47 m)
- Width: 9' 9" (2.97 m)
- Height to lowered collector: 14' 6" (4.42 m)
- One hour rated Horsepower: 3830 (2857 kW)
- Tractive Effort at one-hour rating: 40,800 lbs (181.5 kN)
- Continuous Horsepower: 3490 (2604 kW)
- Tractive Effort at 25% adhesion: 62,000 lbs (275.8 kN)
- Maximum Speed: 70 mph (113 km/h)
- Wheel Diameter: 45 inches (1143 mm)
- Gear Ratio: 67:19
- Control Voltage: 120V D.C.
- Minimum Curve Radius: 330ft (100.6 m)

- Multiple Unit Operation: Up to 4 units

The Metrovick electrical equipment includes; six MV272 traction motors, MG86 supply motor generator, MG92 exciter motor generator, two 20P pantographs and two AY52 compressor motors (fitted to two Westinghouse 2C75 compressors). Traction control is by means of the Metrovick "unit switch" system (electrically interlocked individual electro-pneumatic contactors). Control equipment is of the 1955 type, with manual notching and regenerative braking, directly operated by the driver's master controller (or jumpered train lines when operating in multiple unit).

Thus, from January 1957 until January 1960, 4615 would have seen exclusive use on the western line to Lithgow, hauling both passenger and goods services. For a period before the introduction of the single-deck interurban electric train sets in 1958, 46 class locomotives also hauled the famous commuter expresses "The Fish" and "The Chips" until September and December 1958 respectively. In 1960 electrification of the Northern Line to Gosford was completed, with 46 class electric locomotives again being used to overcome capacity limiting gradients either side of the Hawkesbury River Bridge.

Most 46 class locomotives had a long service life, with all but two still in service early in 1990. However from this time onwards members of the class were progressively withdrawn, with the last 16 in service being stopped during January 1996. 4615 was one of these, being stopped on 17 January 1996, along with 6 others. This was the last day of service for the class, with official stowage being effected the same day.

After the withdrawal, staff at Lithgow Locomotive Maintenance Centre, which maintained the electric locomotive fleet, selected 4638 as the officially retained operational heritage 46 class loco, on the basis of it being the last unit overhauled. Due to very good electrical and mechanical condition, and a late equipment change, 4615 was designated the companion heritage unit to 4638, with it also being retained in operable condition. For this purpose 4615 received a minor service which particularly included refitting of original Metrovick pantographs.

Control of the 46 class locomotives passed from the State Rail Authority of NSW to the newly corporatised FreightCorp (which operated all the previously SRA freight services). Thus 4615 was sold by FreightCorp to the Sydney Electric Train Society on 20th April 1998. Other preserved 46 class units are held by the NSW Rail Transport Museum (4601 and 4638), and Railway Museums at Dorrigo (4602), and Rothbury (4627). All retained units other than 4601 are complete. The remaining balance of the class were scrapped at Simsmetal Mascot in mid to late 1998.



4615 in April 1998 in Lithgow yard sidings adjacent LMC with other stored 46 class units. Photograph by Hugh Burns.

After completion of remedial trackwork on their branch line, 4615 was transferred to the State Mine Heritage Park and Railway at Lithgow for storage on 4th October 1998. 4615 was also the last 46 class locomotive to leave Lithgow Maintenance Centre, being operated out and across Lithgow Yard under electric power.

Following the SETS "86 Class Farewell Tour" on 7th September 2002 (which marked the end of commercial use of electric locomotives in NSW), key staff from Lithgow Locomotive Maintenance Centre urged that 4615 be returned to traffic and generously offered their assistance. After an inspection confirmed that the locomotive remained in excellent mechanical and electrical condition, these works were completed between October and early December 2002.

4615 was transferred from State Mine back down to Lithgow Yard (and under the overhead) on 30th November 2002. It was successfully trialed light engine to Mount Victoria and return on 5th December 2002. The locomotive was operated light engine from Lithgow to Eveleigh in Sydney on 6th December, and ran its first scheduled Society trip on the 7th December 2002 - the "Airport Colliery 46 Class Tour".



4615 sits at the end of the overhead on the Sandown line on 20th December 2002. Photograph by Hugh Burns.

4615 also made a test run trip to Sandown on Friday 20th December 2002, becoming the last electric working on this industrial line, due to removal of the overhead wiring over the following weekend. More recently, 4615 was used for track circuit testing on the Eastern Suburbs Railway as part of the Edgecliff turnback alterations completed in February 2004.

In June 2004, the locomotive was given an interim repaint into Indian Red with yellow whiskers and white numbers. This replicates one variation of the original 1968 whiskers livery applied to some members of this class. More extensive restoration of the external bodywork is planned.

The locomotive is operated on Society outings on various occasions, and most recently hauled our "First Passenger Electric Sesqui-Centenary Tour" on the 28th May 2005.

Acknowledgment

The selection, preservation and subsequent operation of 4615 by the Society was made possible with assistance from technical and supervisory staff at the Lithgow Locomotive Maintenance Centre. However, following the cessation of electric locomotive operations in N.S.W. at the end of June 2002, the "Home of the Electric Locomotive Fleet" was closed on 31 March 2003, after 117 years of locomotive depot operations in Lithgow.

Locomotive notes by Stephen Hलगren and Hugh Burns.

Revised Jul 2004

Further Information

Related reading:

DEPARTMENT OF RAILWAYS : MECHANICAL
BRANCH

46 CLASS ELECTRIC LOCOMOTIVES

Operating Instructions

F. P. HEARD
CHIEF MECHANICAL ENGINEER

August, 1957.

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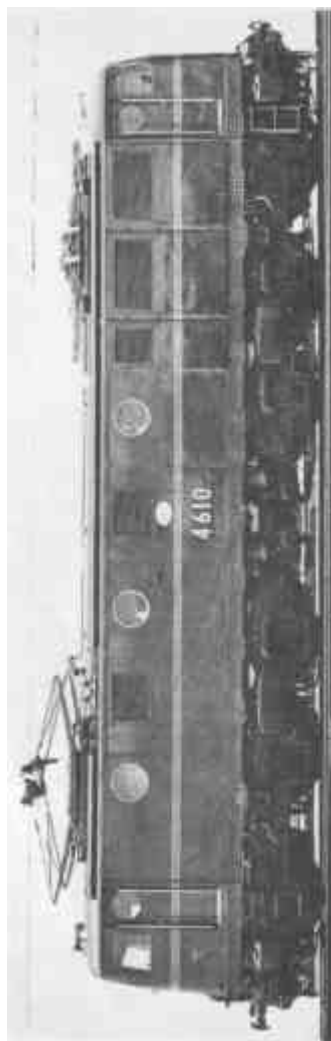


FIG.1. SIDE VIEW.

C O N T E N T S.

PAGE:

General Description:

General particulars	1
Cab	1
Bogies	2
Traction Motors	3
Control Equipment.	3
Brake Equipment	4
Performance	4

Equipment Details:

Wiring diagrams	5
Motor combinations	5
Master controller.	6
Main Isolating Switch.	7
Control Key Switch	8
Overload relays	8
Overvoltage relay.	9
Motor Generator control	9
Air compressor control	10
Pantograph control	10
Resistance fan control	12
Heaters	12
Motor cut out switch.. .. .	13
Isolating cocks	13
Switches & circuit breakers	13

Preparation	16-22
---------------------	-------

Operation procedure:

Acceleration.. .. .	22
Transition	23
Weak field	24
Running notches	24
Reversing.	24
Slipping.. .. .	24
Reduction of speed	25
Section insulators	25

Regenerative Braking:

Speeds.	26
Loads.. . . .	26
When to be used	27
Controller operation	27
Switching off.. . . .	28
Change of combination.. . . .	28
Connection with air brake.. . . .	28
Wheel sliding.. . . .	29
Loss of power.. . . .	29
Over voltage protection	29
Start in series	30
Resistance in series	30
 Pantographs.	 31
Double heading.. . . .	31
Amalgamation	32
Division	33
Stabling	35
Spare & emergency equipment.	36
 Defects in operation:	
Faults during preparation.. . . .	38
Faults in running.. . . .	40
Fan and M.G. Indicator light	41
Resistance fan inoperative.	42
Supply M.G. inoperative	42
Exciter M.G. inoperative	43
Compressor inoperative.	43
Overload relay tripping	43
Interruption of overhead supply	44

LOCATION OF ILLUSTRATIONS.

<u>Figure:</u>	<u>Title:</u>	<u>Facing Page:</u>
1	Side view	Frontis piece
2	End view	1
3	Driving position	4
4	Driver's switch panel	5
5	Pantograph valves and door interlocking	6
6	Door interlock bolt	7
7	H.T. Compartment No.1 end	8
8	Low tension panel No.2 end	9
9	Circuit breaker panel No.1 end	10
10	Compressor and governor	11
11	Pantograph & control and timing reservoirs	12
12	Pantograph three way cock, service position.	13
13	Pantograph three way cock, raising from storage reservoir.	14
14	Pantograph three way cock, charging position.	15
15	Machine compartment	16
16	Motor cut out switch and spare H.T. fuses.	17
17	Power connections	End of book.
18	Sequence of contactors.	"
19	Control circuits part I	"
20	Control circuits part II	"
21	Auxiliary control circuits	"
22	Lighting and power point circuit.	"
23	Brake piping	"
24	Locomotive diagram	"



FIG.2. END VIEW.

GENERAL DESCRIPTION.

The 46 Class electric locomotives of which 40 are on order in Great Britain are a development from 4501 which was built as a prototype. Both types of locomotives have the same wheel arrangement and maximum tractive effort, but the 46 class has more powerful motors than the 45 class, and can maintain its maximum tractive effort at higher speeds.

The locomotive is illustrated in figures 1 and 2.

The driving position is illustrated in figure 3.

The 46 class electric locomotives will be used for hauling passenger and goods trains between Sydney and Lithgow when the electrification to Lithgow is completed in 1957.

General particulars are as follows:-

Voltage	1500 D.C.
Wheel arrangement	C + C.
Mass	111 tons.
Axle load	18.5 tons
Wheel diameter	45 inches
Bogie wheel base	14'0"
Total wheel base	41'0"
Length over buffers	54'0"
Overall width	9'9"
Height from rail level to pantograph, closed	14'6"
Tractive effort at 25% adhesion	62,000 lbs
Tractive effort at the one hour rating	40,800 lbs
Speed at the one hour rating	34.5 mph.
One hour rated horse power	3840
Continuous horse power	3480
Maximum speed	70 mph.
Low tension supply	120 volts D.C.

CAB.

The cab has a driving position at each end with comfortable accommodation for driver and

assistant driver. The cab ends are specially shaped to give an attractive appearance.

Between the two driving positions the locomotive houses control equipment, motor generator sets and traction motor blowers, and air compressors. The space between the centre longitudinals of the underframe is enclosed and forms an air duct for the traction motor ventilating air.

The underframe rests on the bogies through centre castings, side bearers, and bearers on the ends of the bogies.

The locomotive is well ventilated by louvres, and provided with circular windows. There is a passage from each driver's cabin to the machinery compartment in the centre.

BOGIES.

The bogies are one piece steel castings. On the outer ends of the bogies are mounted buffers and draw gear. The inner ends of the bogies are coupled together by a draw bar having spherical bushes at each end.

The inner ends of the bogies are aligned by a lateral control spring which is provided with an initial compression. Relative movement between the inner ends of the bogies increases the compression of this spring.

Centre castings are provided on the bogie transoms to take the centre castings on the underframe. The bogie centre castings can move laterally on a slide but are restrained in the central position by springs having initial compression.

The centre casting on one bogie is allowed a small amount of longitudinal movement to prevent binding on curves.

At the end of each bogie there is an end bearer mounted on rubber, and fitted with an

initial compression of the rubber. They align the bogies with the underframe and take the reaction caused by the tractive effort on the bogies. The springing on each side of each bogie is fully compensated. Each axle box is provided with a laminated spring and two helical auxiliary springs.

Axle boxes are of the single bearing self aligning SKF roller type.

TRACTION MOTORS.

There are six traction motors per locomotive, each rated at 640 h.p. at the one hour rating, and 580 h.p. continuously, at 725 volts. The motors have six poles, and are lap wound.

Armature bearings are of the roller type and axle suspension bearings are of the sleeve type. Pinions are of nickel chrome case hardening steel, and the gear wheel rims are of nickel chrome oil hardening steel. The gear wheel rims are mounted on the gear wheel centre through rubber bushes.

The traction motors are located laterally in the bogies by rubber bushed links. This relieves the ends of the suspension bearings of thrust.

The traction motor nose is mounted between rubber pads.

CONTROL EQUIPMENT.

The control equipment is arranged for the motors to be connected either six in series, two parallel circuits each of 3 motors in series, or three parallel circuits each of two motors in series. Five weak field positions are provided in each combination. Contactors are of the electro-pneumatic type.

Resistances are of strip metal type. They are provided with blowers which come into operation when the resistances are in circuit for over a prescribed time.

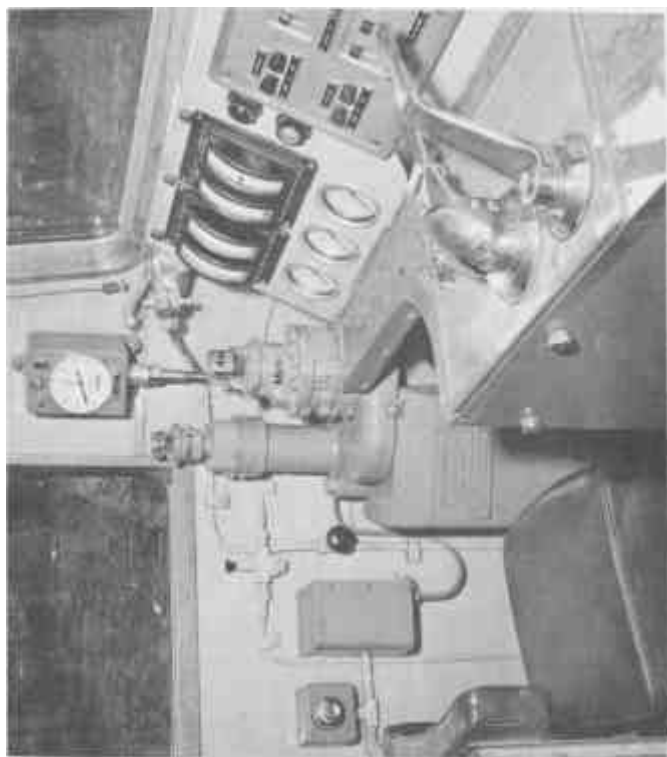


FIG.3. DRIVING POSITION.

Provision is made for regenerative braking in series and series-parallel.

The control voltage is 120 D.C.

There are two motor generator sets each driven by 1500 volt motors. One set includes a 120 volts D.C. generator which provides power for lighting and control and for battery charging. The other set includes a variable voltage generator which is used for separately exciting the traction motor fields during regeneration.

Each motor generator set also drives a fan which discharges into the air duct between centre longitudinals of the underframe and passes thence to the traction motors. Each motor is blown with 2500 cubic feet per minute.

The battery consists of 54 cells of the lead acid type with a capacity of 50 amp hours.

The two pantographs are of the double pan type. They are raised by air pressure controlled by electro-pneumatic valves operated from the driver's position. A hand pump is provided for use in the absence of air pressure.

BRAKE EQUIPMENT.

There are two air compressors, each having a displacement of 75 cubic feet per minute. Each is driven by a 1500 volt motor.

Brake equipment is of the Australian Westinghouse A-7-EL type. A diagram of the piping is shown in figure 23.

PERFORMANCE.

The locomotives are designed to haul 1100 tons at 35 mph on the rising 1/90 grades between Zig Zag and Newnes Junction, and 400 tons at 35 mph on the rising 1/33 grades between Valley Heights and Katoomba. Where grades and curves permit they can haul passenger trains at 70 mph.

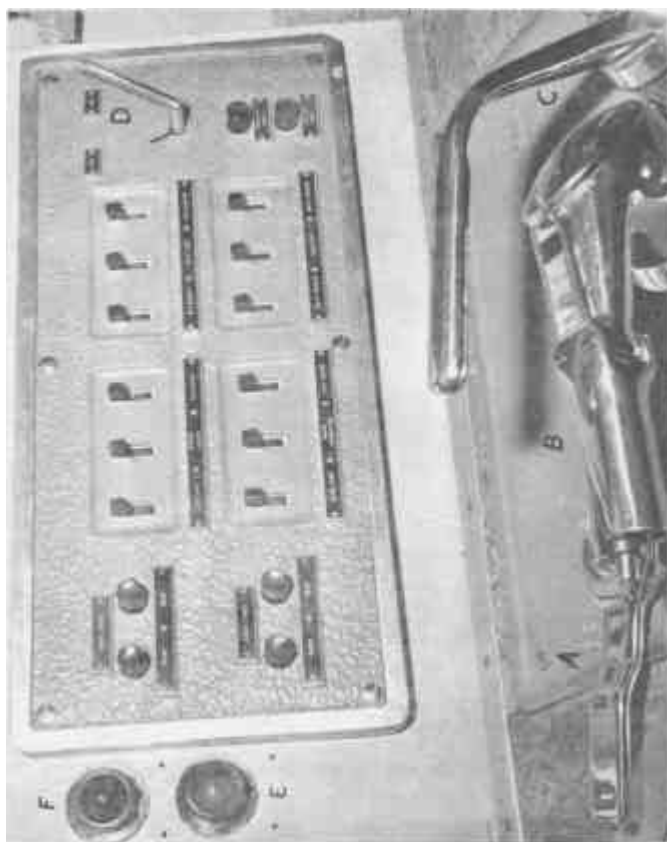


FIG.4. DRIVER'S SWITCH PANEL.

EQUIPMENT DETAILS.WIRING DIAGRAMS.

- Figure 17 shows the power connections.
- Figure 18 shows the sequence of contactors.
- Figure 19 shows part 1 of the control circuits schematically.
- Figure 20 shows part 2 of the control circuits schematically.
- Figure 21 shows the auxiliary control circuits schematically.
- Figure 22 shows the lighting and power point circuits schematically.
- Figure 24 is a locomotive diagram, showing the leading dimensions.

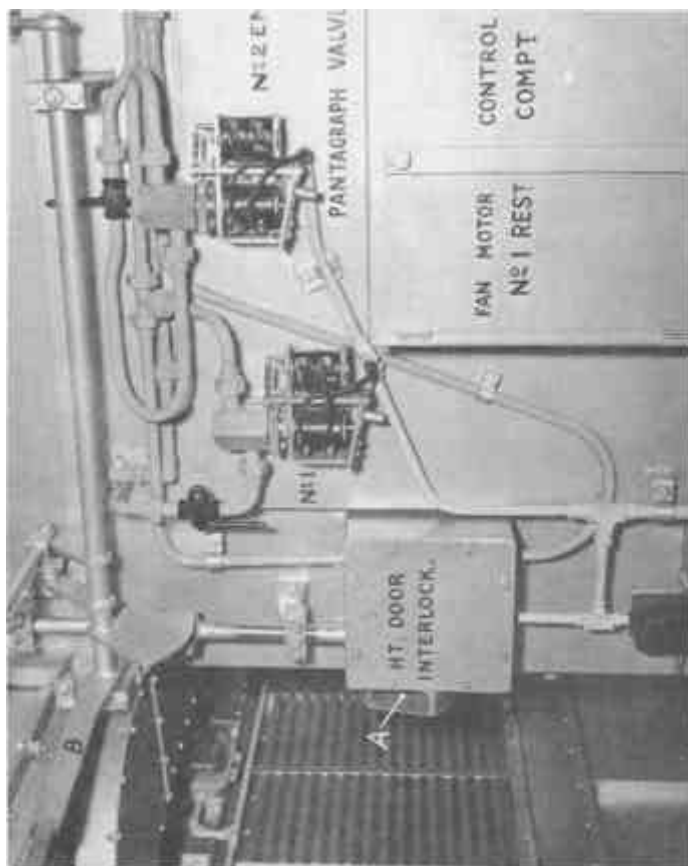
MOTOR COMBINATIONS.

Each locomotive is equipped with six M.V.272 traction motors which are axle mounted. Motors Nos. 1, 2 and 3 are on one bogie and motors Nos. 4, 5 and 6 on the other bogie.

The motors can be connected in any of three speed combinations by electro-pneumatic unit switches:

- (1) Series - six motors in series.
- (2) Series-Parallel - two parallel circuits each of three motors in series.
- (3) Parallel - three parallel circuits each of two motors in series.

In each combination resistance is first included in circuit with the motors. It is cut out by moving the accelerating handle of the master controller from the off position to position No.20.



**FIG.5. PANTOGRAPH VALVES &
DOOR INTERLOCKING.**

After all resistance has been cut out in each combination there are five stages of weak field.

MASTER CONTROLLER.

There is a master controller in each driving cabin. It has the following three handles which are shown in figure 4:-

REVERSING HANDLE. (A in figure 4).

This handle has three forward positions which are:-

Forward series,
Forward series-parallel,
Forward parallel.

It has two reverse positions which are:-

Reverse series,
Reverse series-parallel.

The reverse handle can only be removed when it is in the off position. It can not be moved to the off position unless the accelerating handle is in the off position.

ACCELERATING HANDLE. (B in figure 4).

The accelerating handle has the following positions:-

- 0 Off position.
- 1-20 Accelerating notches, commencing on notch 1 with all resistances in circuit with the motors, and ending on notch 20 with no resistance in circuit.
- 21-25 Weak field notches. These notches give higher running speeds than notch 20 which is a full field notch.

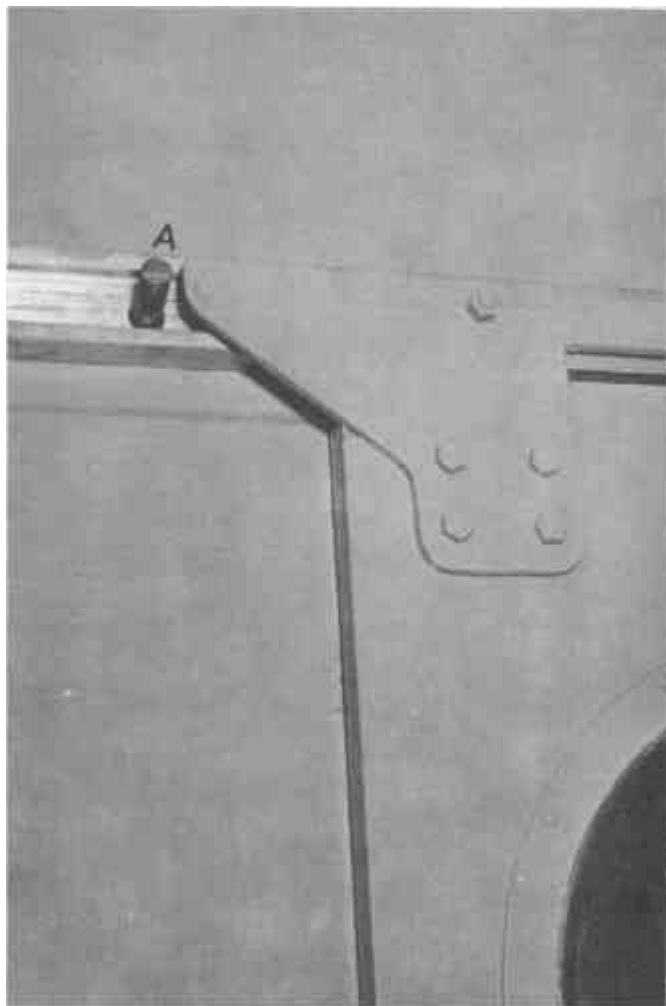


FIG.6. DOOR INTERLOCK BOLT.

REGENERATING HANDLE. (C in figure 4).

This handle is used for regulating the strength of the traction motor fields during regeneration and therefore the speed. It has the following positions:-

- Mot - This position corresponds to the off position of the handle. The handle is always left in this position except when regenerative braking is taking place.
- 1-15 - In these positions the traction motors are separately excited for regeneration and the field strength is increased from position 1 to position 15. 1 is the highest speed running position and 15 the lowest speed position.

The regenerating handle cannot be moved from or to the motoring position unless the accelerating handle is in the off position.

Although regeneration is set up by moving the regeneration handle to any of positions 1 to 15 it does not actually commence until the accelerating handle has been moved to the first position. The accelerating handle should be steadily moved to position 20.

MAIN ISOLATING SWITCH.

It is necessary for this switch to be closed for any of the 1500 volt equipment to operate. The switch is interlocked with the doors of the high tension compartment so that the switch cannot be closed unless the doors are closed, and the doors cannot be opened unless the switch is open, and the equipment earthed.

The switch is unlocked by the reverser handle on a knob in the opening shown at "A" in figure 5. In this figure the handle "B" is used for operating the switch and unlocking the H.T. compartment doors. In the position shown in this figure the doors are unlocked and isolating switch opened. This handle

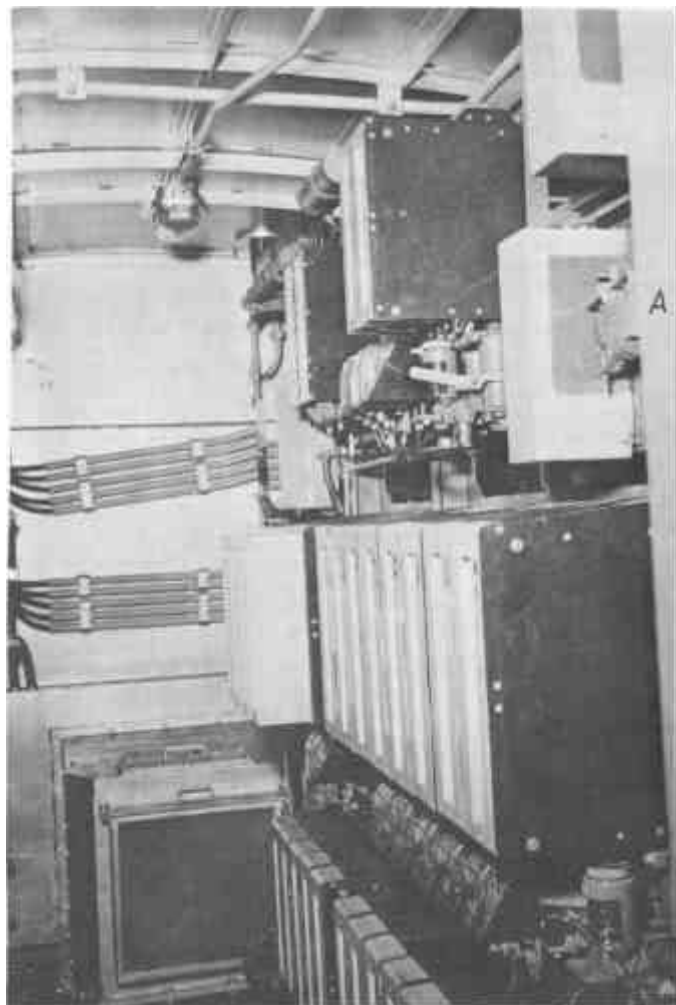


FIG.7. H.T. COMPARTMENT NO.1. END.

cannot be moved until the H.T. door interlock has been freed by lowering the pantographs.

The projecting bolt shown at "A" in figure 6 is operated by the handle "B" of figure 5.

CONTROL KEY SWITCH.

In order to obtain control current for the pantograph raise circuit, compressor control, and master controller it is necessary that the control key switch be closed. This switch is operated by the same key that operates the driver's cabin door. It is important that when locomotives are coupled together, with the jumpers inserted, only one key switch should be closed on all locomotives.

The switch is illustrated in the "On" position at "D" in figure 4.

OVERLOAD RELAYS.

In case there is a fault on the 1500 volt equipment, the locomotive is provided with overload and differential overload relays which can trip.

The overload relays are shown in figure 7 at "A".

When these relays trip on excessive current they cause the line switches to open.

The overload relays trip if excessive current passes through their coils. The differential overload relay trips if the amount of current flowing into the power circuit is different from the amount flowing out. This indicates a fault in the equipment. It is necessary to set the differential overload relay if the control switch has been switched off.

Overload relays are reset by pressing the "reset" button on the driver's panel. This button is shown in figure 4 immediately under the key switch.



FIG.8. LOW TENSION PANEL NO.2. END.

They should not be reset more than twice in succession. Repeated resetting would damage the equipment and might start a fire.

OVERVOLTAGE RELAY.

This relay is required during regeneration and opens the line switches if the voltage which is being generated greatly exceeds the nominal line voltage. It is reset by pressing a push button on the driver's switch panel. This button is shown in figure 4 below the overload reset button.

Neither the overload relays nor the over-voltage relays can be reset unless the accelerating handle of the master controller is in the off position.

MOTOR GENERATOR CONTROL SWITCHES.

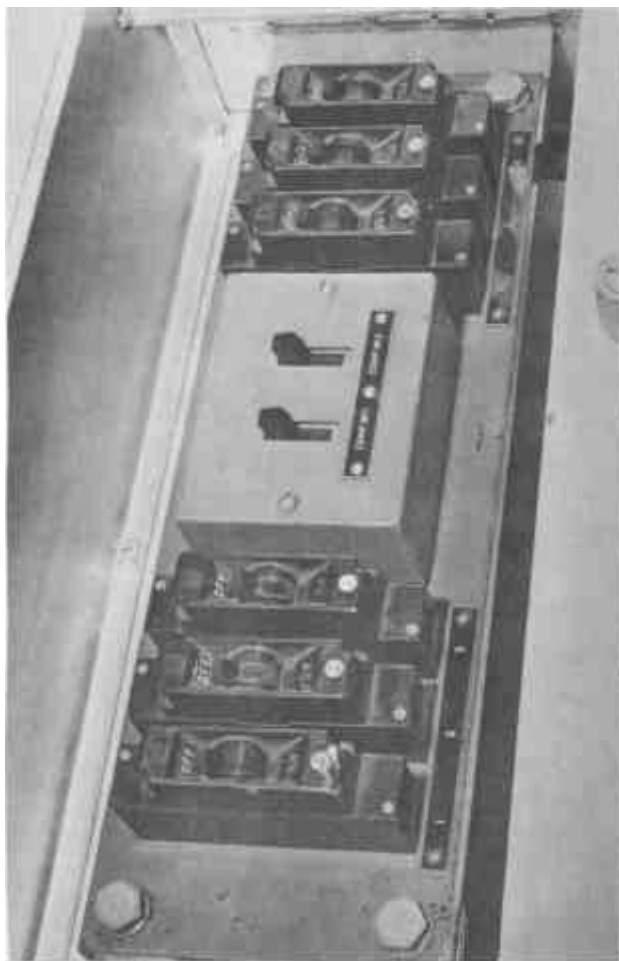
While the locomotive is in service it is necessary for both the motor generators to be running to provide ventilating air for the traction motors. Also the supply motor generator set must be running to provide 120 volt control current and keep the battery charged.

Each motor generator set is provided with a no current relay which makes contact if the machine is not running, and lights a yellow lamp in each driver's cabin, as a warning to the driver. This lamp is shown at "E" in figure 4.

For the supply motor generator to be running it is necessary that the miniature circuit breaker in the low tension switch board and the motor generator two-way tumbler switch on one of the driver's desk panels should be closed.

The supply M.G. circuit breaker is No.1 in figure 8. The M.G. Tumbler switch is that labelled "motor generators" in figure 4.

For the exciter motor generator to be running it is necessary that its circuit breaker on



**FIG.9. CIRCUIT BREAKER PANEL
NO.1. END.**

the low tension switch panel should be closed and the supply motor generator to be running.

The exciter M.G. circuit breaker is No.7 in figure 8.

AIR COMPRESSOR CONTROL.

For the air compressors to be running it is necessary that the control key switch be "On", the circuit breaker controlling them on the low tension switch panel and the compressor control switches on the same panel be closed. There is a separate control switch for each compressor so that either may be switched on while the other is idle. The normal operating condition is for both compressors to be switched on.

The compressor control circuit breaker is that numbered 3 in figure 9 and the two switches in the centre of this figure are the compressor control switches.

There is a compressor governor in the compressor control circuit. When main reservoir air pressure is built up to the pressure at which the governor is set, normally 125 pounds per square inch, the governor stops the operation of the compressors. When the pressure has fallen to 105 pounds per square inch the operation starts again.

The compressor governor is shown at "A" in figure 10.

PANTOGRAPH CONTROL.

The pantographs are raised by air pressure at 70 pounds per square inch from the pantograph and control reservoir. After the locomotive has been shut down for some time they are raised by air from the pantograph storage reservoir, or by a hand pump.

In the air supply from the pantograph and control reservoir there is an isolating cock which is connected to the interlocking mechanism

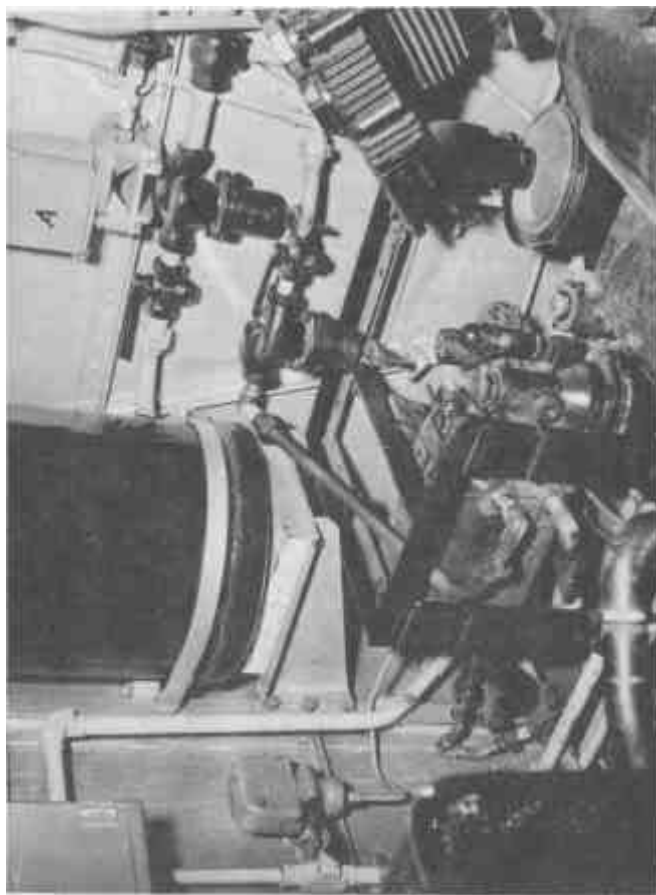


FIG.10. COMPRESSOR & GOVERNOR.

for the doors of the high tension compartments. This cock is enclosed in the H.T. Door interlock box illustrated in figure 5. This prevents the pantographs being raised until the doors are closed and locked. The air supply to the pantograph also passes through a three-way cock, illustrated at "A" in figure 11. The three positions of this cock are as follows:-

- (1) In this position the handle is horizontal and the pantographs are connected via their electro-pneumatic pantograph valves to the pantograph air supply. This is the normal position of the cock while a locomotive is in service. See figure 12.
- (2) In this position the handle points upwards and the pantographs are connected via their electro-pneumatic pantograph valves to the storage reservoir. In this position one of the pantographs can be raised from the storage reservoir by opening the storage reservoir wheel valve. See figure 13. The storage reservoir is shown at "A" in figure 15. This figure also shows the pantograph hand pump which must be used if the storage reservoir is depleted. The wheel valve is not shown in the figure but is to the right of the reservoir.
- (3) In this position the handle is vertical pointing downwards. The storage reservoir is connected to the air supply so that it can be charged by opening its wheel valve. After charging, the wheel valve should be tightly closed to prevent loss of air. In this position the pantographs are lowered and isolated. See figure 14.

There are two pantograph electro-pneumatic valves, one for the control of each pantograph. Each valve is operated by two push buttons, "up" and "down" in each driving cabin. All front or all rear pantographs can be operated together if locomotives are coupled in multiple unit.



FIG.11. PANTOGRAPH & CONTROL AND TIMING RESERVOIRS.

These pantograph valves are shown in figure 5. This figure also shows the pantograph isolating cocks. In this figure the cock for No.1 pantograph is open, and that for No.2 pantograph is closed. The normal position is for both cocks to be open.

The pantograph push buttons are clearly shown to the left of the switch panel in figure 4.

CONTROL OF RESISTANCE FAN MOTORS.

The main resistances are ventilated by motor driven fans which start up after power has been on the main resistors for one minute. They keep running for three minutes after current has ceased to flow in the resistances. During some master controller operations the resistance fans will not operate, it is only when acceleration is unduly prolonged and during regeneration that the fans operate.

Operation of the fans is shown in each driver's cabin by a yellow indicator light which lights up when power is applied to the resistances and a fan is not running. As soon as all fans start running the light goes out.

The same lamp will shine as an indicator for the motor generators. It is shown at "E" in figure 4.

This light should not remain alight for more than one minute. If it does there is a possibility of the resistances becoming overheated.

HEATERS.

Each driver's cabin is provided with heaters, window heaters and a food heater. These are controlled by switches in the driving cabin. Their circuits are protected by circuit breakers on the low tension panel. These switches are shown in figure 4 and the circuit breakers in figures 8 and 9.



**FIG.12. PANTOGRAPH THREE WAY COCK,
SERVICE POSITION.**

MOTOR CUT OUT SWITCH.

In case it is necessary to isolate a defective motor a motor cut out switch is provided. It is operated by the reverse handle of the master controller. Either 1, 2 and 3 motors can be cut out together, or 4, 5 and 6 motors together, or all motors on the locomotive can be cut out. This switch is shown in figure 16. It is in No.1 H.T. Compartment.

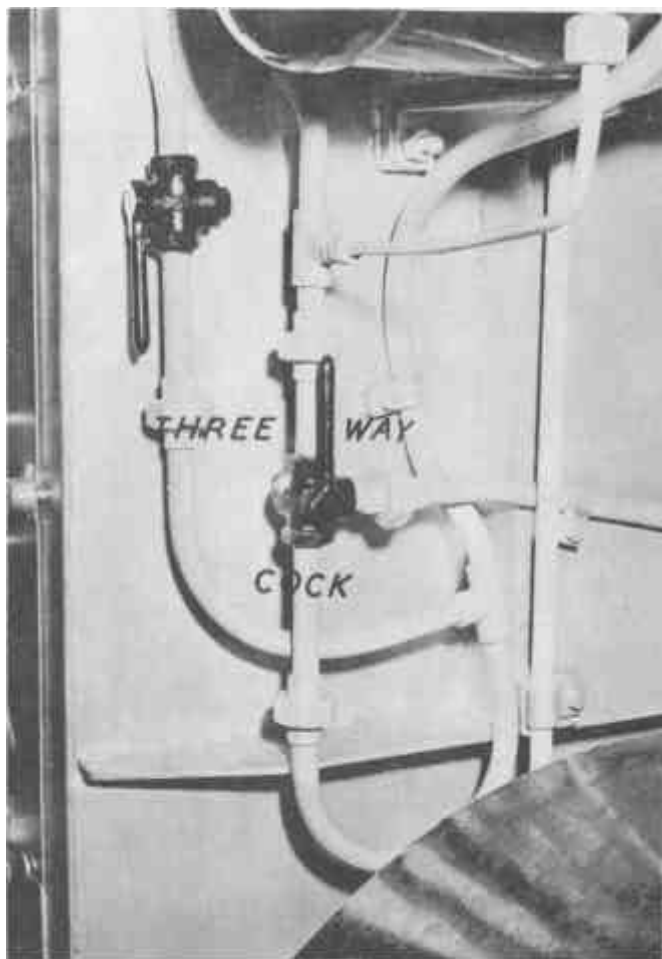
ISOLATING COCKS.

The isolating cocks provided in each locomotive are listed below together with the correct running position of each cock.

Brake valve isolating cock at driving end	open
Brake valve isolating cock at non driving end	closed.
One compressor governor isolating cock	open & sealed)
One main reservoir isolating cock	open
Two pantograph isolating cocks	open
Two pantograph & control reservoir isolating cocks inlet and outlet	open
Three-way pantograph cock	handle horizontal (towards Corridor).
One switchgroup isolating cock	open
One time-delay reservoir isolating cock	open
One sander isolating cock	open
One distributing valve isolating cock	open & sealed.
One dead engine cock	closed
Two brake cylinder isolating cocks	open
All drain cocks	closed
Hose coupling cocks not connected to adjacent locomotive	closed.

SWITCHES AND CIRCUIT BREAKERS.

The various switches and miniature circuit breakers are located as follows:-



**FIG.13. PANTOGRAPH THREE WAY COCK,
RAISING FROM STORAGE RESERVOIR.**

In No.1 H.T. Compartment.

Motor cut out switch.
Main H.T. isolating switch.
Compartment light switch.

In No.2 H.T. Compartment.

Compartment light switch.

In L.T. Cubicle (Back of No.2 Cab). (See figure 8.)

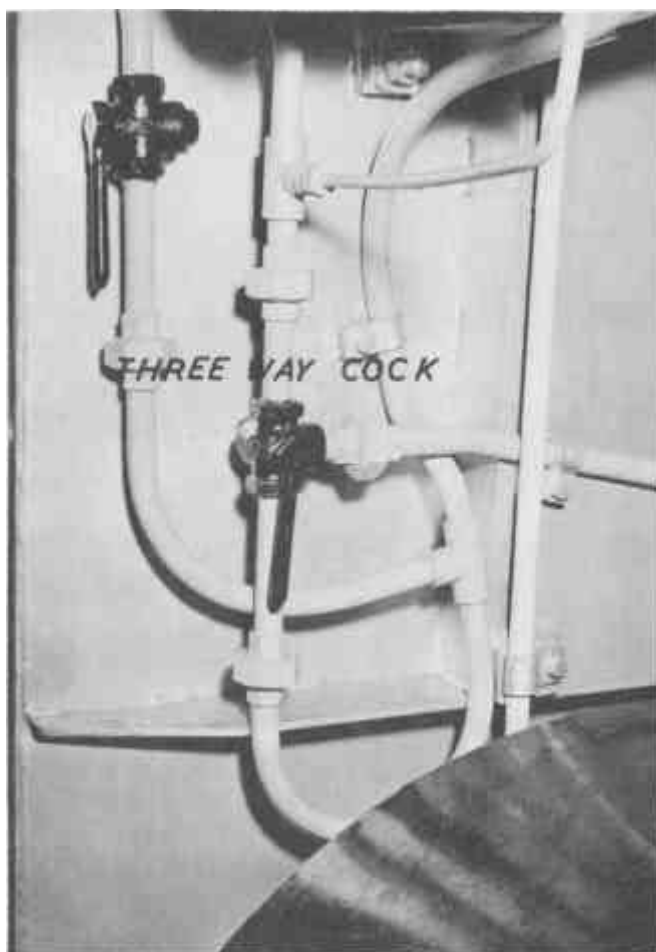
Battery isolating switch.
9 - Miniature circuit breakers (M.C.B's) for:-
Voltage Regulator.
Supply M.G.
Head & Marker lights.
Cab & Compartment lights.
Corridor lights.
Sanding.
Locomotive Brake.
Exciter M.G.
Cab heaters.

In each driving cab.

Control key switch.)	
Motor generator switch)	
Headlight switch)	
Pilot light switch.)	On driver's
Instrument light switch)	switch panel.
Food heater switch)	See figure 4.
Cab heater switch)	
Window heater switch)	
Cab light switch)	
Marker light switches)	

In No.1 Cab only. (In cupboard on back wall).
See figure 9.

Compressor switches.
6 - Miniature circuit breakers for:-
Control main.
Head and Marker lights.
Compressor
Control



**FIG.14. PANTOGRAPH THREE WAY COCK,
CHARGING POSITION.**

Food heater
Cab heater.

In Corridor. (Adjacent to each cab door).

Corridor light switch.

In Machinery Compartment. See figure 11.

8 - Resistance Fan M.C.B's (4 in each of two
cupboards on H.T. Compt. walls).

Outside of locomotive.

4 - Handlamp socket switches (2 each side on
underframe).

2 - Pantograph isolating switches (1 each end
of roof).

To operate locomotive lights the battery isolating switch must be closed, together with the lighting M.C.B's. Individual groups of lights are then controlled by their respective switches as required.

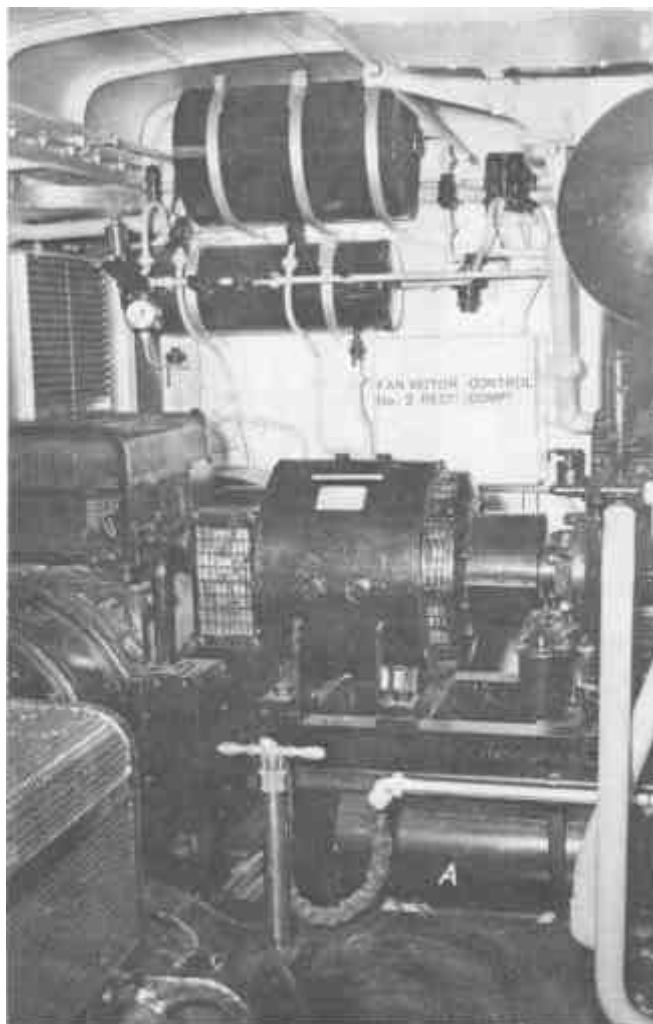


FIG.15. MACHINE COMPARTMENT.

PREPARATION AND STABLING.

1. In the event of any equipment being found "Cut out" unless labelled "Not to be used", or in the absence of a relevant entry in the Log Book, such equipment must be "Cut In".
2. If any authorised employee be at work on an electric locomotive at the time when the driver arrives to commence testing operations, and if such work is likely to affect the electrical or air equipment, the driver must not proceed with the testing operations on the locomotive concerned, or cause the locomotive to be moved, until the work has been completed and all danger tablets removed from the departure end of the locomotive.
3. When an electric locomotive is stabled at a depot, the procedure outlined for stabling must be carried out by the stabling driver, unless instructed not to do so by the Shed Chargeman.

PREPARATION.

1. Obtain Driver's Daily Report Sheet, Reverser Key and Control Key. On arrival at Locomotive observe that both pantograph isolating switches are closed. Peruse Depot Officers Certificate and commence preparation at No.2 end.
2. Enter cab and see that Hand Brake is "On" and locked.
Check that all L.T. Circuit breakers are closed and place battery switch to "In" position.
Switch on light to prove Battery fuses.
Battery switch to be placed to "Out" position before L.T. fuses are renewed.
See all switches on Driver's switch panel are up and "Off".
Switch Cab and Corridor lights "On" if required.
See that Driver's Brake Valve Isolating Cock is closed.
See that No.2 H.T. Compartment door is closed.

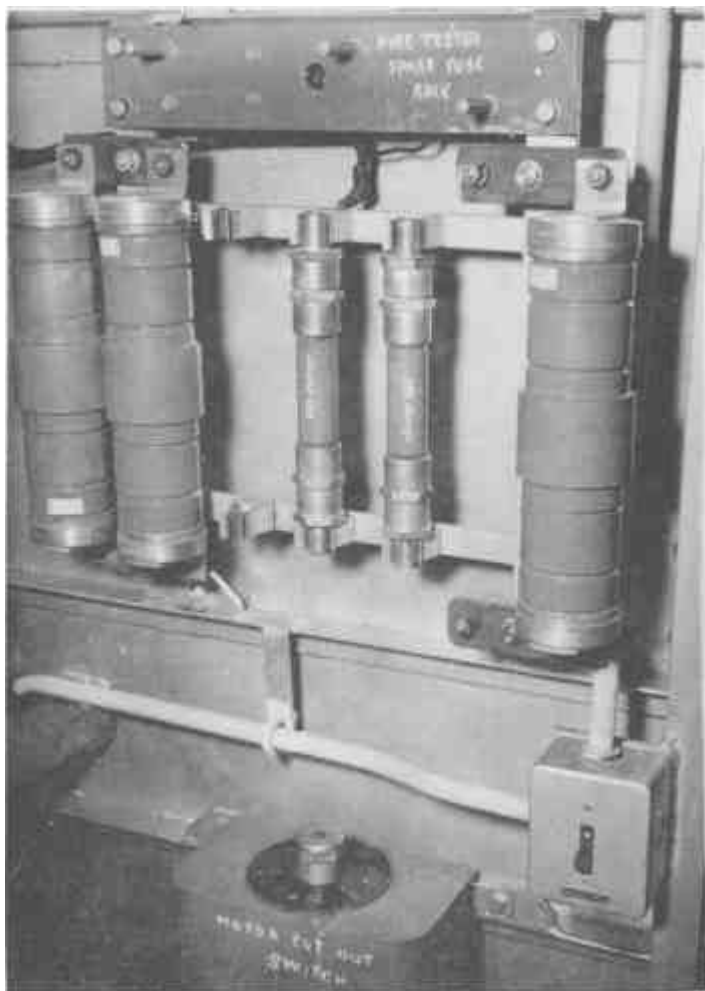


FIG.16. MOTOR CUT-OUT SWITCH AND SPARE H.T. FUSES.

3. Pass through locomotive to No.1 end and unlock it.

Check that all L.T. circuit breakers are closed and compressor switches are up and "Off".

See all switches on Driver's switch panel are up and "Off".

See Driver's Brake Valve isolating cock is closed.

Open door of H.T. Compartment.

See motor "Cut Out" switch in No.1 H.T. Compartment is in "All in" or relative position as shown in Log Book.

Check spare H.T. fuses and check that required H.T. fuses are in circuit. Close No.1 H.T. Compartment door.

4. Return to Machine (centre) compartment.

Check that Fan resistance circuit breakers are Down and closed.

Check spare equipment in compartment:-

3 Control Jumpers - A. B. & C.

2 Air hoses - brake pipe, main reservoir.

3 Bogie Hoses - Main reservoir, Brake cylinder, Sanding.

2 1/2" hose couplings.

1 Fire extinguisher.

1 Hook stick.

Spare light globes:-

1 Head Light Globe 120V, 250 watt.

2 Interior " " 120V, 60 watt.

2 Marker " " 120V, 40 watt.

2 Pilot " " 120V, 15 watt.

Check that seal is on the spare equipment locker.

See that Main Reservoir, pantograph and control reservoir, fan time delay reservoir, switch group, sanding relay, and pantograph isolating cocks are open and, that Main Reservoir to Distributing Valve Isolating Cock and Compressor Governor Isolating Cocks are both open and sealed.

The Dead Engine cock must be closed, the handle pointing to the brake pipe connection on the distributing valve.

Place the door locking lever down and lock

H.T. switch with reverser key (two movements).

Enter No.1 end cabin, insert control key in switch and switch "On".

Press pantograph button to raise pantograph and press button to lower leading pantograph.

If main reservoir gauge shows 50 lbs. the pantograph can be raised with the three-way cock in "Horizontal" position.

If main reservoir is less than 50 lbs place the three-way cock in "Up" position and open wheel valve of storage reservoir. If after opening wheel valve pantograph gauge shows less than 50 lbs and pantograph does not rise, close wheel valve and operate hand pump until pantograph makes good contact with the overhead wire.

Proceed to No.1 end and note line voltage on volt meter and then switch on both compressors.

Return to centre compartment and keep pumping until main reservoir pressure is 70 lbs. Then move three way cock to horizontal position and close wheel valve if not already closed.

5. Go to departure end.

Then switch "On" supply generator. (Exciter Generator will start up automatically when Supply Generator is up to Speed).

Check all spare equipment in departure end cabin including, fire extinguisher, hand lamp, red flags, detonators and "Tail Disc No.1 end", "Spare L.T. fuses No.2 end".

Test head, pilot, marker, gauge and interior lights and set required Head and Marker lights.

Test whistle, windscreen wipers and raising and lowering operation of both pantographs.

NOTE: Before lowering or raising pantographs the motor generators and compressors must be switched off.

Open Driver's Brake Valve isolating cock and test independent and automatic brake valves in the following manner:-

NOTE: During the following tests the "Cutting in" and "Cutting out" points of the air compressor governor should be checked. Any irregularities detected should be reported, and this also applies to incorrect pressures or adjustments that are noticed on other tests.

TEST 1 - AIR PRESSURES.

With full main reservoir pressure and with both driver's brake valve handles in "running" position, check air gauges to ensure that correct air pressures are being carried. Main reservoir pressure should be governed within the limits of 105 to 125 p.s.i. - Brake Pipe pressure as necessary for the work to be performed and to be in accordance with that shown in Regulation 2, Clause (a), Sub-Clause (iv) of the Westinghouse Brake Regulations, Page 207, General Appendix Part 1 (i.e. Setting of reducing valve).

TEST 2 - MINIMUM REDUCTION FEATURE.

Move the automatic brake valve handle to "lap" position and check that the "minimum reduction" feature is operating.

TEST 3 - INDEPENDENT RELEASE OF AUTOMATIC BRAKE.

Move the independent brake valve handle to "quick release" position, to release brake application, and thence to "running" position.

TEST 4 - AUTOMATIC BRAKE VALVE - SERVICE OPERATION.

Increase the brake pipe reduction to 20 p.s.i. by means of the automatic brake valve and note the rise in pressure as shown on brake cylinder air gauge.

TEST 5 - REGENERATIVE INTERLOCK (a).

Before making the regenerative interlock test place the reverser key in forward series, press overload and overvoltage reset buttons, then place the accelerating handle in the first notch noting that a current reading is recorded on the ammeter. Return the accelerating handle and reverser key to the off position. With the auxiliary generator and the regenerative exciter running, reverser handle in forward series, place the regenerative handle in first position and with the accelerating handle also in the first notch, note that the air brake application releases.

TEST 6 - REGENERATIVE INTERLOCK (b).

Reduce the brake pipe pressure to zero, and check that the automatic control switch operates to cut out regenerative brake and that the air brake re-applies on the locomotive. Return the accelerating handle to the "Off" position.

TEST 7 - FLOWMETER TEST.

Return the automatic brake valve handle to "running" position and note that one hand of the Flow Indicator Gauge momentarily drops towards zero and then returns to the normal fully charged position, overlapping other hand.

TEST 8 - INDEPENDENT APPLICATION WITH REGENERATION.

Place the accelerating handle in the first notch.
Move the independent brake valve handle to "slow" application position and check that a brake application is obtained and that the setting of the reducing valve (45 p.s.i.) is correct and leave handle in this position.

Move the accelerating handle to the "Off" position, the regenerative handle to "MOT", and reverser key to "Off" position.

TEST 9 - DISTRIBUTING VALVE SAFETY VALVE.

Reduce brake pipe pressure by 20 lbs. with the automatic brake valve handle in "service" Position and check that the distributing valve safety valve lifts when 55 p.s.i. brake cylinder pressure has been obtained. Release brakes by returning both brake valves to "running" position.

6. Move reverser key to either Forward or Reverse Series position.
Test Sanding device.
Move Reverser key to "Off" position and remove key.
Make application of the brakes in slow application position with Independent Driver's Brake Valve, close D.B.V. Isolating Cock and remove both D.B.V. handles.
See that Hand Brake is applied and alight from cabin.
Examine front of locomotive, checking all air cocks are closed and dummy couplers in correct position.
See auto. coupler is in good order and jumper receptacle lids properly closed.
7. Pass along "Off" side of locomotive.
Examine brake shoes and riggings, springs etc. and see that Resistance Compartment doors are closed and securely fastened.
Check that Air Brake Cut Out cocks are open, sand boxes full and working correctly and Brake piston travel between 3-1/2" and 5".
8. Enter rear end cabin and carry out instructions as previously outlined in Clause 5.
Note that air pressures indicated on the air gauges do not materially differ from those indicated at the other driving compartment.

Set required Tail lights and release Hand Brake if applied.

9. Examine rear and "On" side of Locomotive as outlined in clause 6 and 7.
10. Enter departure end cab.
Open Driver's Brake Valve Isolating cock, release Hand Brake and lower leading Pantograph if not required.
Insert Reverser Key in Master Controller in readiness to depart.
11. Apply power in first notch "Forward" and "Reverse" and see that operation is correct.

NOTE: Blown H.T. fuses are to be placed in box provided in No.1 H.T. Compartment and blown L.T. fuses left in bottom of Battery Switch cupboard, No.2 cabin.

OPERATION PROCEDURE.

ACCELERATION IN SERIES.

To start a train or light engine the following actions are necessary:-

- (1) The control key switch must be in the "On" position.
- (2) Place the reverser handle on the Master Controller and move it to series forward or reverse as required.
- (3) Press the overload reset button.
- (4) Release the brakes.

The accelerating handle can then be moved to the first position and after a pause to the second position and so on.

If the locomotive is light it should move in the first position. If on the other hand a heavy train is attached it may be necessary to go to the 6th or 7th position to get the train moving.

After the train has started to move the accelerating handle should be moved step by step to position 20. The peak current measured on the ammeter should not exceed 1000 during notching. Peak currents in excess of 800 amperes will probably require the use of sand to prevent wheel slip. Another notch should not normally be taken until the current drops below 850 amperes.

After the accelerating handle has reached position No.20 it can be left in that position if no higher speed is required. Generally this speed will be insufficient and it will be necessary to pass to the next combination, in accordance with the following description:

TRANSITION FROM SERIES TO SERIES-PARALLEL.

The controller handle positions at the end of the previous acceleration are:

Reverse handle in "forward" "series".
Accelerating handle in position 20.

To change into the series-parallel combination the reverse handle is moved from "forward" "series" to "forward" "series-parallel".

The accelerating handle is then returned to notch 1 with the button on the end of the handle depressed. The button on the end of the handle prevents the controller handle going to off, during transition.

No change takes place until the accelerating handle is returned to notch 1. As soon as this happens transition to "series-parallel" takes place with all resistances in circuit. The handle should then be advanced step by step to position 20 as before.

TRANSITION FROM SERIES-PARALLEL TO PARALLEL.

If a higher speed than is obtained in the series-parallel combination is required, tran-

sition to parallel should be made. The reverse handle should be moved to "Forward" "parallel" position and the accelerating handle returned to No.1 position. This will make the transition to parallel with all resistances in circuit. The accelerating handle should then be moved step by step up to notch 20 as before.

WEAK FIELD NOTCHES.

There are five (5) positions of the accelerating handle after notch 20. In these positions the fields of the traction motors are weakened which increases the locomotive speed.

These notches should be used if a higher speed than can be obtained in full field is required, and if the next higher motor combination will give too high a speed.

Weak field notches should not be used at less than the speeds shown below:-

<u>Combination:</u>	<u>W.F.Notch.</u>	<u>Minimum Speed.</u>
Series	1 to 5	12 m.p.h.
Series-parallel	1 to 3	22 m.p.h.
Series-parallel	4 and 5	30 m.p.h.
Parallel	1 to 3	35 m.p.h.
Parallel	4 and 5	50 m.p.h.

RUNNING NOTCHES.

Positions 20 to 25 of the accelerating handle are running notches, and the handle may be left continuously in any of these positions. It should not be left continuously on any of positions 1 to 19, as in these positions resistances are in circuit with the traction motors and they are not designed for continuous operation. (An exception to this instruction is given under series regeneration).

REVERSING.

The reverser handle should never be thrown to reverse while the locomotive is moving forward, nor to forward while the locomotive is moving in reverse. The locomotive should be stopped before a change in the direction of the reverser handle is made.

WHEELS SLIPPING.

Wheel slip relays operate a lamp and buzzer in each driver's cabin if a wheel slip of over 7 m.p.h. occurs. The lamp and buzzer also operate during transition from series-parallel to parallel.

Wheel slips should be quickly corrected by the use of sand and by the accelerating handle being moved back until the slip stops.

In weak field a slipping speed high enough to burst an armature can be attained if these notches are used below a speed prescribed on page 24.

REDUCTION OF SPEED.

If on a rising grade it is necessary to reduce speed, the accelerating handle should be returned slowly to the off position, the reverse handle should be moved to a lower speed combination and the accelerating handle advanced to notch 20.

SECTION INSULATIONS IN OVERHEAD WIRE.

Section insulators in the overhead wire separate sections of the wire and there can be a difference of voltage between the two sides.

To reduce sparking at section insulators whenever practicable the locomotive should be coasted under them. Drivers should make a habit of switching off power while the pantographs are passing under section insulators.

REGENERATIVE BRAKING.

During regeneration the power generated by the motors is fed back to the overhead wire for use by other trains.

Regenerative braking is available in the series combination at speeds of approximately 15 m.p.h. and upwards.

Maximum retardation is available at 15 m.p.h., but above this speed the maximum amount of braking effort obtained falls off in inverse ratio to the speed. For instance at 30 m.p.h. the maximum braking effort obtainable is only half that obtainable at 15 m.p.h.

Regenerative braking is also available in the series-parallel combination at speeds of 30 m.p.h. and upwards. In this case full braking can be obtained at 30 m.p.h. and the maximum braking falls off in inverse ratio to the speed.

It should be noted that full braking effort can be obtained at only two speeds, namely 15 m.p.h. in series and 30 m.p.h. in series-parallel.

Operation at other speeds means a reduction in the amount of braking obtainable.

The maximum loads which can be braked at a steady speed on different grades without overheating the traction motors, or danger of wheel sliding are as follows:-

Grade.	Load which can be braked in series at <u>15 mph or series-parallel at 30 mph.</u>
1/33	580 tons.
1/40	760 tons.
1/60	1250 tons.
1/80	1850 tons.
1/90	2150 tons.

WHEN REGENERATIVE BRAKING SHOULD BE USED.

The regenerative brake is designed to maintain an approximately constant speed when descending grades and it should be used for this purpose. If rapid deceleration or a stop is required the automatic air brake should be used.

As the regenerative brake is applied only on the locomotive care must be taken to avoid sudden application or release which would impart a shock on the train.

OPERATION OF MASTER CONTROLLER IN REGENERATION.

If the speed is between 15 and 30 m.p.h. place the reverser handle in "forward" "series".

If the speed is above 30 m.p.h. place the reverser handle in "forward" "series-parallel".

Place the regeneration handle on a notch corresponding to the speed.

The following table shows the position of the reverser handle and regeneration handle for various speeds:-

Approx m.p.h.	60,	40,	30,	26	30,	20,	15,	13
Combination	Series-parallel				series			
Regen. notch	1,	5,	10,	15	1,	5,	10,	15

The proper position of the handle is indicated by the reading of the motor voltmeter which should approximately balance with the line voltmeter.

As soon as the regeneration handle has been placed in the appropriate position the accelerating handle should be moved steadily round to No.20 position.

The regeneration handle should then be moved to suit the speed and braking effort required. Movement of this handle should always be effected slowly.

Movement towards notch 15 increases braking effort and movement in the opposite direction decreases it.

TO SWITCH OFF.

When it is desired to switch off regeneration the regeneration handle should be moved slowly until the armature current is zero. The accelerating handle should then be returned to the off position. The regeneration handle should then be returned to the motoring position.

If while regeneration is in operation it is necessary to make a rapid decrease in speed, the automatic air brake should be applied on the train. It is important that as soon as the armature current reads zero the accelerating handle should be returned to the off position. Otherwise the locomotive may take a motoring current.

CHANGE OF COMBINATION.

To change from series to series-parallel or vice versa in regeneration it is necessary to switch off, adjust the speed of the train with the air brake and commence regeneration again in the new combination.

CONNECTION OF REGENERATION WITH AIR BRAKE.

As soon as the accelerating handle is moved from the off position to commence regeneration, a regeneration interlock magnet valve on the distributing valve is energised. This enables an automatic air brake application to be made on the train without taking effect on the locomotive.

If, however, an emergency application of the automatic brake is made, the heavy reduction

of brake pipe pressure thus caused operates a pneumatic switch which cuts off regeneration, and thereby, switches off the regeneration interlock magnet valve, so that an emergency brake application is effective on the locomotive as well as on the train.

WHEEL SLIDING DURING REGENERATION.

The motor armature current should generally be kept at less than 700 amperes to prevent wheel sliding during regeneration. If wheel sliding occurs it is possible for the speed of the train to increase rapidly, so a close watch on the speed should be kept.

If wheel sliding occurs an immediate application of the automatic air brake should be made to check the speed. This will reduce the braking effort being exerted by the locomotive and stop the wheel sliding. At the same time the regeneration handle should be moved to reduce the amount of braking.

LOSS OF OVERHEAD POWER.

If overhead power is lost while a train is descending a steep grade an immediate application of the automatic air brake, sufficient to stop the train, should be made, and this application must not be released until power is restored and main reservoir pressure exceeds 105 lbs per square inch.

This instruction must be observed whether or not regeneration is in operation, as it is essential that the brakes be applied before main reservoir pressure has been depleted. The instructions on page 259 of the General Appendix Part I apply.

OVER VOLTAGE PROTECTION.

If the voltage generated by the traction motors exceeds 2050 volts the overvoltage relay will trip and cut off regeneration. Care should

be exercised in setting up regeneration not to allow the motor volts to greatly exceed the line volts before connection is made to the line by movement of the accelerating handle to notch 20.

If the overvoltage relay trips during regeneration an automatic air brake application should be made. The accelerating handle should be returned to the "off" position and the regenerating handle to the motoring position. The overvolt reset button should then be pressed after which regeneration may be commenced again.

The line voltage should not be allowed to exceed 2000 volts. It can be reduced by reducing the current regenerated, and if necessary using the automatic air brake to give the braking required.

START IN SERIES REGENERATION.

A train may be started in series regeneration from rest if on a falling grade.

The regeneration handle should be placed in notch 2, and the accelerating handle advanced notch by notch to position 20, and the regeneration handle adjusted as required.

The locomotive will take a motoring current to start after which on a falling grade a braking current will be generated.

A start in series-parallel regeneration from rest must not be made.

RESISTANCE IN SERIES REGENERATION.

In series regeneration the accelerating handle may be moved back as far as notch 12 to insert resistance in the motor circuit, this will allow of a slight increase in speed in this combination. This working does not apply to series-parallel regeneration.

PANTOGRAPHS.

Most wear on the overhead wire is caused by passage of current to the pantograph strips rather than by friction between wire and strips. It is therefore desirable at all times when hauling a train to operate with both pantographs raised. The current density at the pantograph strips is thereby kept as low as possible and the rate of wear on the overhead wire kept as low as possible.

When running light only the rear pantograph should be raised.

PANTOGRAPHS WHEN DOUBLE HEADED.

The overhead wire for the suburban area to the east of Westmead is too light to allow for four (4) pantographs being raised on two locomotives coupled together. Excessive lift of the contact wire would occur and there would be possible damage to pantographs at cross spans.

The overhead wire to the west of Westmead is of heavier construction and allows four adjacent pantographs to be raised.

Double headed up trains passing through Westmead must have the leading pantograph on each locomotive lowered. The driver should do this by first switching off power, then pressing the pantograph "front" "Lower" button on the panel on the driver's desk.

DOUBLE HEADING.

When double heading it is the normal practice for two locomotives to have jumpers inserted between them and for both machines to be controlled from the leading driving cabin.

Each locomotive is prepared as described in preparation instructions.

Each locomotive carries three jumpers and two 1/2" hose couplings. One set of these fittings should be inserted at the point of coupling. The couplings for the 1/2" hose are duplicated on each side, but a pair of hoses should be fitted on one side only. The brake pipe and main reservoir hose pipes should be coupled. The hose pipe cocks at each end of each hose pipe should be opened.

When uncoupling two locomotives the jumpers and the 1/2" hose pipes removed from the point of coupling should be placed in the locomotive not equipped with these parts.

CONTROL AND BRAKE VALVE HANDLES.

When double heading the control key switch, reverser handle, automatic brake valve handle, and the independent brake valve handle should be in position on the appropriate equipment in the leading driver's cabin.

In the rear locomotive, the control key, and reverser handle should be removed from the equipment and placed on the bottom of the low tension panel at No.2 End.

AMALGAMATION: DUTIES OF DRIVER & OBSERVER.

1. Observer: Secure the stationary locomotive or locomotives by applying the hand brakes unless the stationary locomotive is attached to a train standing with brakes applied. Open the automatic coupler, signal the driver to ease up, and, when coupled, couple the main reservoir and train pipe hoses and open the four air cocks.
2. Driver: Obtain the three jumpers and two half inch air hoses from the hook in the passageway of the locomotive, hand them down to the observer on the ground, and alight from the locomotive. Hand the jumpers ('B' jumper first) and the air hoses to the observer at

foot plate level.

3. Observer: Place the jumpers and half inch hoses on the ground taking care to avoid dirt getting in to the ends, climb to foot plate level between the two locomotives, and receive the jumpers from the driver ('B' jumper first), and insert them in their respective receptacles. Place the half inch hoses in position on one side and open the air cocks.
4. Driver: Test the operation of the pantographs first from the leading locomotive then from the second locomotive, and release the hand brakes applied at the beginning of the amalgamation.

DIVISION.

Duties of Driver and Observer.

1. Observer: Climb to foot plate level, close the control and independent release pipe air cocks, remove the two half-inch hoses and hand them to the driver on the ground. Remove the three jumpers ('B' jumper last) and hand them to the driver.
2. Driver: Place the two half-inch air hoses and three jumpers on the ground taking care to avoid dirt getting into the ends. Enter the cab and receive the air hoses and jumpers from the observer.
3. Observer: After handing the air hoses and jumpers up to the driver, close the main reservoir and brake pipe cocks, uncouple the hoses, open the brake pipe cock on the stationary loco., and signal the driver to ease up to uncouple. When the locomotive is uncoupled, close the open brake pipe cock, attach the dummy couplers to the air hoses and to the control and independent release pipes of both locomotives, close the jaw of the automatic coupler, and secure the stationary

locomotive by applying the hand brakes.

4. Driver: When the locomotive is uncoupled, place the jumpers and air hoses on the hook in the passage-way of the locomotive not already equipped with these parts.

STABLING.

When the locomotive has been brought to a stand at the point of stabling the following duties should be carried out.

Close the driver's brake valve isolating cock. Leave the automatic brake valve handle in the running position and the independent brake valve handle in the lap position.

Apply the leading hand brake hard on and lock it.

Switch off the supply motor generator at the tumbler switch on the driver's desk.

Switch off compressors, heaters and lights.

Press both pantograph down buttons and lower pantographs.

Check that the pantographs are down by visual observation.

Turn pantograph three-way cock to the down position, opening the storage reservoir wheel valve and charging the storage reservoir. Close wheel valve tightly. Close the P & C reservoir inlet and outlet cocks.

Remove the control switch key and the reverser handle, walk around the locomotive and make sure there are no defective parts. Enter any defects in the Log Book.

When leaving locomotive open battery switch, make sure that all doors are locked and windows closed.

DRIVERS, SPARE AND EMERGENCY EQUIPMENT.

The following equipment shall be carried in each 46 class electric locomotive:-

DRIVER'S EQUIPMENT.

- 2 Hand lamps. One in each driver's cabin.
1 Tail disc. In No.1 cabin.
2 cases of 12 detonators. One in each cabin.
2 red flags (in flag cases). One in each cabin.

FOR COUPLING TO ANOTHER LOCOMOTIVE.

- 2 1/2" hose couplings. In No.2 End Corridor
3 Jumper couplings. In No.2 End Corridor.

TOOLS.

- ```

1 Spanner, hose M.R.& T.L.)
1 " " Bogie M.R.)
1 " " " B.Cyl.)
1 " " " Sand)In sealed box in
1 Pin punch 3/8")No.1 end corridor.
1 Chisel)
1 Hammer)
1 Spanner, fuse.)
1 Inspection light & lead)

```

## SPARE AND EMERGENCY EQUIPMENT.

- ```

1 Air hose M.R. 3/4" )
1 " " T.L. 1" )
1 " " B.Cyl 1" )
1 " " Sand 1/2" )In open box in
1 Rope 40 ft. )No.1 end
1 Light globe, headlight 250W.)corridor.
1 " " interior 60W.)
1 " " marker 40W.)
1 " " pilot 15W.)
2 Fuses, Main Aux. H.T. 150A In rack in No.1
H.T. Compt.
2 " Gen H.T. 50A In rack in No.1
H.T. Compt.

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2	Fuses, Comp.	H.T.	18A	In rack in No.1 H.T. Compt.
1	"	Voltmeter	9.5A	In rack in No.1 H.T. Compt.
2	"	L.T. Gen & Battery	100A	On bottom of L.T. Panel No.2 end.

Spent H.T. fuses to be placed in box in No.1
H.T. Compartment.

Spent L.T. fuses to be placed in bottom of No.2
L.T. Panel.

1	Hook stick.	In No.1 end corridor.
3	Fire Extinguishers.	One in each cabin and centre compartment.

DEFECTS IN OPERATION.

The following are hints to assist in overcoming operating troubles which may be experienced.

FAULTS DURING PREPARATION.

1. Lights will not go on when M.G. is not running.

- a) Check that Battery isolating switch is closed.
- b) Check that miniature circuit breakers (MCB) are "On".
- c) Check Battery Fuses.

2. Pantograph will not go up.

- a) Check that H.T. doors are closed and completely locked.
- b) Check Control key switch is "On".
- c) Check that amber light on desk is showing.

If not - Check that the lights work (See 1).
Check that "Control Main" M.C.B. is on.
Check that "Control" M.C.B. is on.

- d) Check that correct air pressure is available.
- e) Check that pantograph isolating cocks are open.

3. Line Voltmeters do not register.

- a) Check that pantograph is up (See 2).
- b) Check that roof switches are closed.
- c) Check voltmeter fuses (9.5 amps).

4. Compressors will not start.

- a) Check control key switch is "On".
- b) Check Voltmeter is reading (See 3).

If motor generators are not running, and amber light is not showing, then:-

- c) Check (i) that lights work (See 1).
- (ii) "Control Main" M.C.B. is "On".
- (iii) "Control" M.C.B. is "On"
- d) Check "Compressors" M.C.B. is "On".
- e) Check 18 Amp. Compressor fuses.
- f) Check 160 Amp. Main H.T. Auxiliaries fuse.
- If one compressor only will not start,
- (i) Check 18 Amp Compressor fuses.

NOTE: The Compressors will not start if main
Reservoir pressure is above 105 p.s.i. gauge.

5. Motor Generators will not start.

- a) Check that Compressors will start (See 4).
- b) Check that (i) "Supply M.G." M.C.B. is
"On".
- (ii) "Exciter M.G." M.C.B. is
"On".
- c) Check Switchgroup isolating cock is open.
- d) Check 50 Amp Supply M.G. H.T. Fuse.

6. Exciter M.G. set only will not start.

- a) Check that "Exciter M.G." M.C.B. is "On".

7. Cab, Food and Window Heaters.

- a) Check that M.G. Sets are running, as other-
wise heaters are not available.
- b) Check the appropriate M.C.B.s.

8. Sanders will not operate.

- a) Check that "Sander" M.C.B. is "On".
- b) Check that Sander Isolating Cock is open.

9. Horns will not operate.

If main reservoir pressure is available,
horns are defective.

FAULTS IN RUNNING.Procedure when locomotive will not move or loses power when motoring or regenerating.

If on a steep falling grade bring the train to a stand by the automatic air brake.

Return master controller to "Off" position and set reverser key to FORWARD SERIES.

Check control key switch is in "ON" position, and reset over-load and overvolt relays.

Take Notch 1 on accelerating handle.

If motor ammeter reads, electrical circuits are now normal, and the locomotive can proceed.

If motor ammeter does not read, return accelerating handle to "OFF" and carry out the following checks to prove the locomotive supply circuits.

Check for	Supply is proved if:-	Action if no supply.
1. OVERHEAD SUPPLY	Line Voltmeter Reads or Motor Generators Operate or Compressors Operate.	Ensure Panto in contact with wire & Panto Isolating Switches closed. If these are OK await restoration of power.
2. BATTERY SUPPLY	Motor Generators Operate or Compressors Operate or Any loco lights Operate.	Check Battery Isolating switch closed & battery fuses O.K.

Check for	Supply is proved if:-	Action if no supply.
3. CONTROL CIRCUIT SUPPLY	Compressors Operate or Unit switches Operate or Indicator Lamps Light.	Check Main and Control M.C.B's.
4. CONTROL AIR SUPPLY	Motor Generators Operate or Any Unit switch Operates.	Check all Isol- ating cocks on P & C Reservoir and Switch- group.

RESISTANCE FANS AND MOTOR GENERATORS INDICATOR LIGHTS.

There is an indicator lamp on each driver's panel for the resistance fan motors and for the motor generators. If this lamp is alight it indicates either that one of the motor generators has stopped, or that one of the resistance fans has stopped. If the lamp is alight when the accelerating handle is in the off position the indication is that one of the motor generators has stopped.

When double headed the indicator light shows whether a resistance fan or a motor generator on either locomotive is not operating.

When the accelerating handle is on notches 1 to 19 the lamp will normally light and stay alight for approximately one minute.

If it remains alight for more than one minute there is indication of trouble with the resistance fan motors or one of the motor generators. In this case:-

Check that both motor generators are running.
Check that all eight fan circuits breakers on the low tension panels in the centre compartment are closed.

RESISTANCE FAN INOPERATIVE.

If both motor generators are running it is probable that one or more of the fan motors has stopped, and repeated accelerations will over-heat the resistances.

Resistance should not be inserted during series regeneration.

The resistances are designed to stand two successive starts each taking five minutes without the fans operating.

If the fans are not operating and additional starts are required it may be necessary to wait for the resistances to cool down.

SUPPLY M.G. INOPERATIVE.

If the supply motor generator is inoperative, the ventilating air to the traction motors is greatly reduced and care must be taken to avoid overheating the motors. In such conditions the average motor currents must not exceed the following values:

700 amps for 30 minutes.
550 amps for 60 minutes.
450 amps for continuously.

If the load is such that the current exceeds these values the train must be placed in the first siding to avoid damage to the motors, and the locomotive worked light to a depot.

The regenerative brake and the resistance fans are inoperative.

EXCITER M.G. INOPERATIVE.

If the exciter M.G. is inoperative the average motor currents should not exceed the figures shown under previous heading.

The regenerative brake and resistance fans will be inoperative.

ONE COMPRESSOR INOPERATIVE.

The locomotive may be operated normally, but a close watch should be kept on the main reservoir pressure.

OVERLOAD RELAY TRIPPING.

Tripping of the overload relays will be indicated by lighting of the line switch indicator lamp, F in figure 4, a sudden loss of power, and zero readings on both ammeters.

The M.G. sets will continue to operate and the line voltmeter will register.

The accelerating handle should be returned to the off position and the overload relay reset button pressed. The accelerating handle can then be notched up again carefully.

The overload relays should not be reset more than twice in succession.

After the tripping of the overload relays the locomotive should not be operated beyond full series for 1 minute, nor beyond series-parallel for a further period of 5 minutes.

After the overload relays have tripped twice in succession and the load of the train is more than that shown below it will be necessary to obtain assistance.

<u>GRADE.</u>	<u>LOAD.</u>
1/33	175 tons
1/40	250 tons
1/60	350 tons
1/90	550 tons

If the load is less than that shown, Nos.1, 2 and 3 motors should be cut out by setting the motor cut out switch to "1, 2 & 3 OUT". The overload relays should be reset, the reverser handle moved to series-parallel, and an attempt made to proceed in this combination.

Only the series-parallel position is effective with motors cut out. Regenerative braking is inoperative. The line switch indicator lamp is inoperative with motors cut out.

If the overload relays trip again, Nos.1, 2 and 3 motors should be cut in and 4, 5 and 6 motors cut out. The overload relays should be reset again and an attempt made to proceed in series-parallel.

If the overload relays trip again the locomotive is a total failure.

When double headed the line switch indicator lamp shows whether the overload relays have tripped on either locomotive.

INTERRUPTION OF OVERHEAD SUPPLY.

This will be shown by loss of indication on the line voltmeter. The line switches will open through the action of the no current relay which is de-energised on loss of line voltage.

Return the accelerating handle to the "OFF" position and when power is restored, as indicated by the line voltmeter, and main reservoir air pressure has been restored, notch up again in the normal manner.

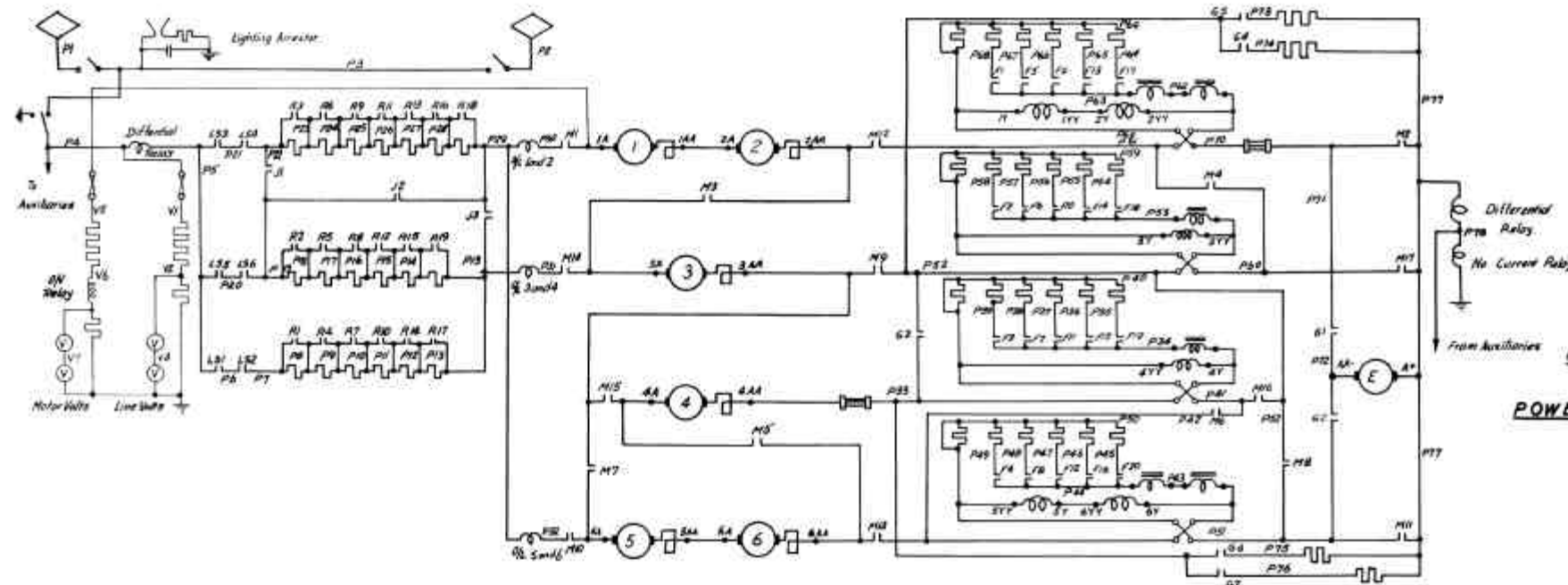
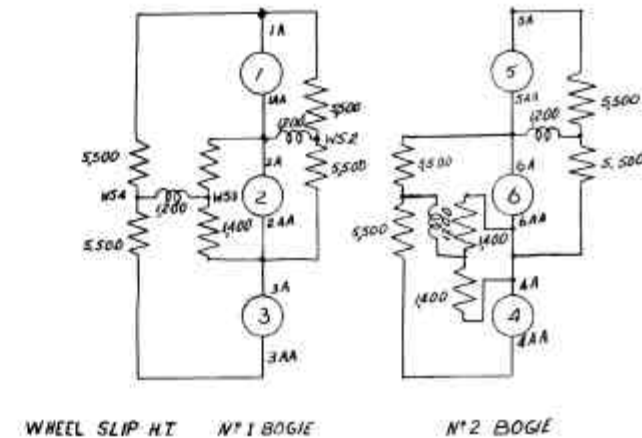
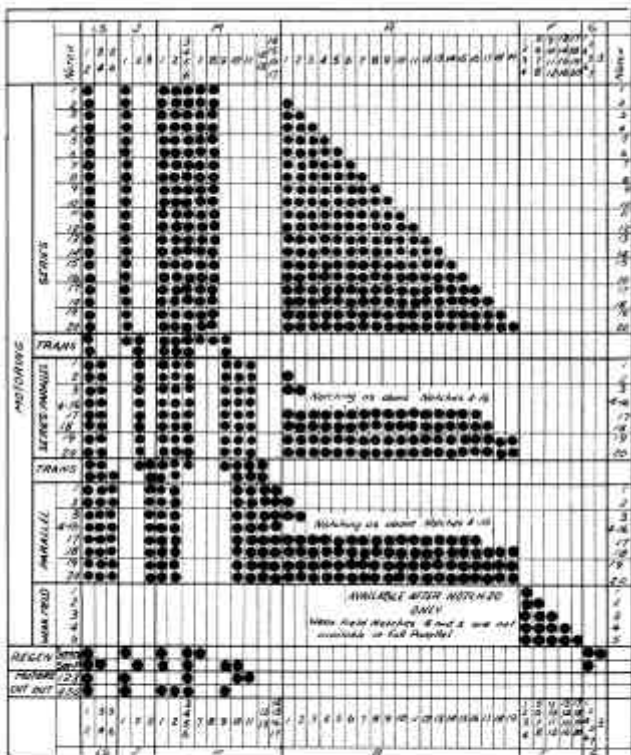


FIGURE 17

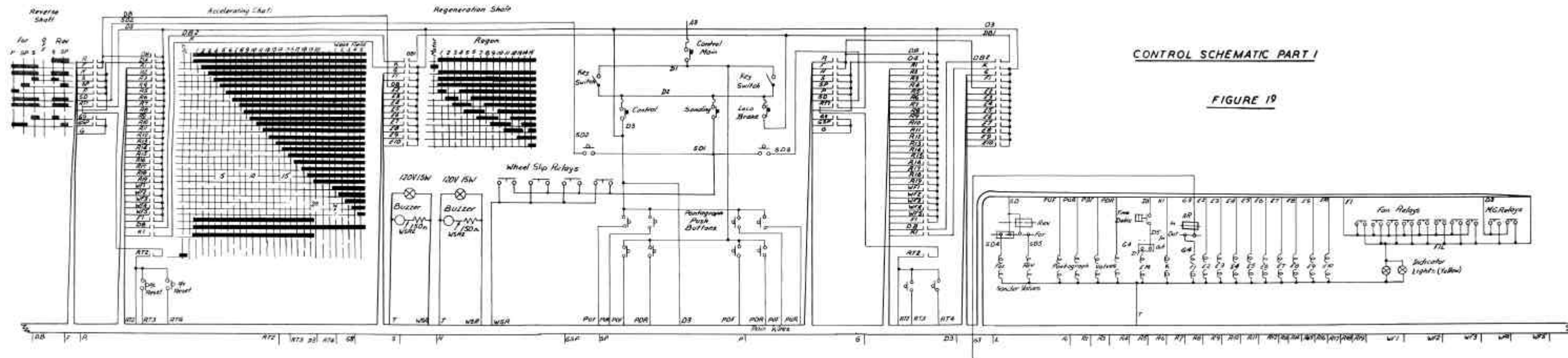
POWER CONNECTIONS





SEQUENCE OF SWITCHES.

FIGURE 1B.



CONTROL SCHEMATIC PART I

FIGURE 19

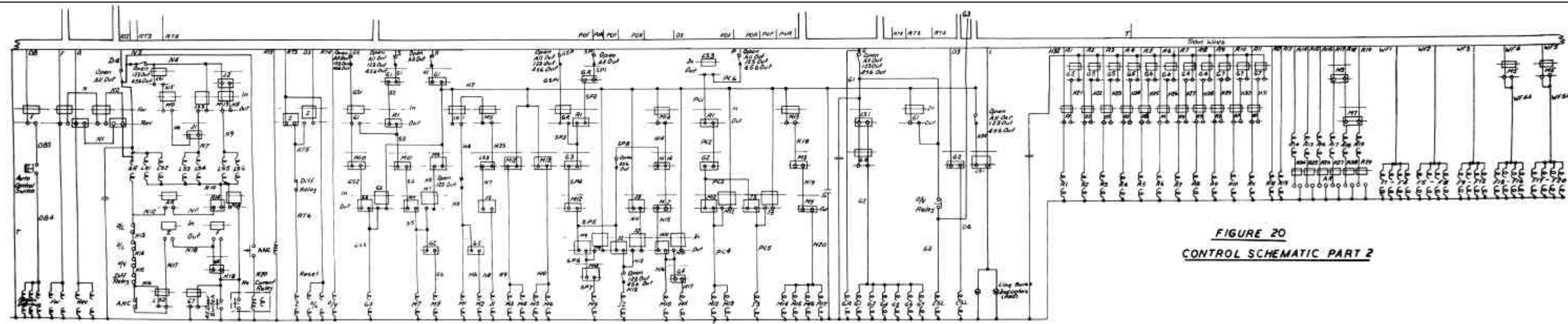
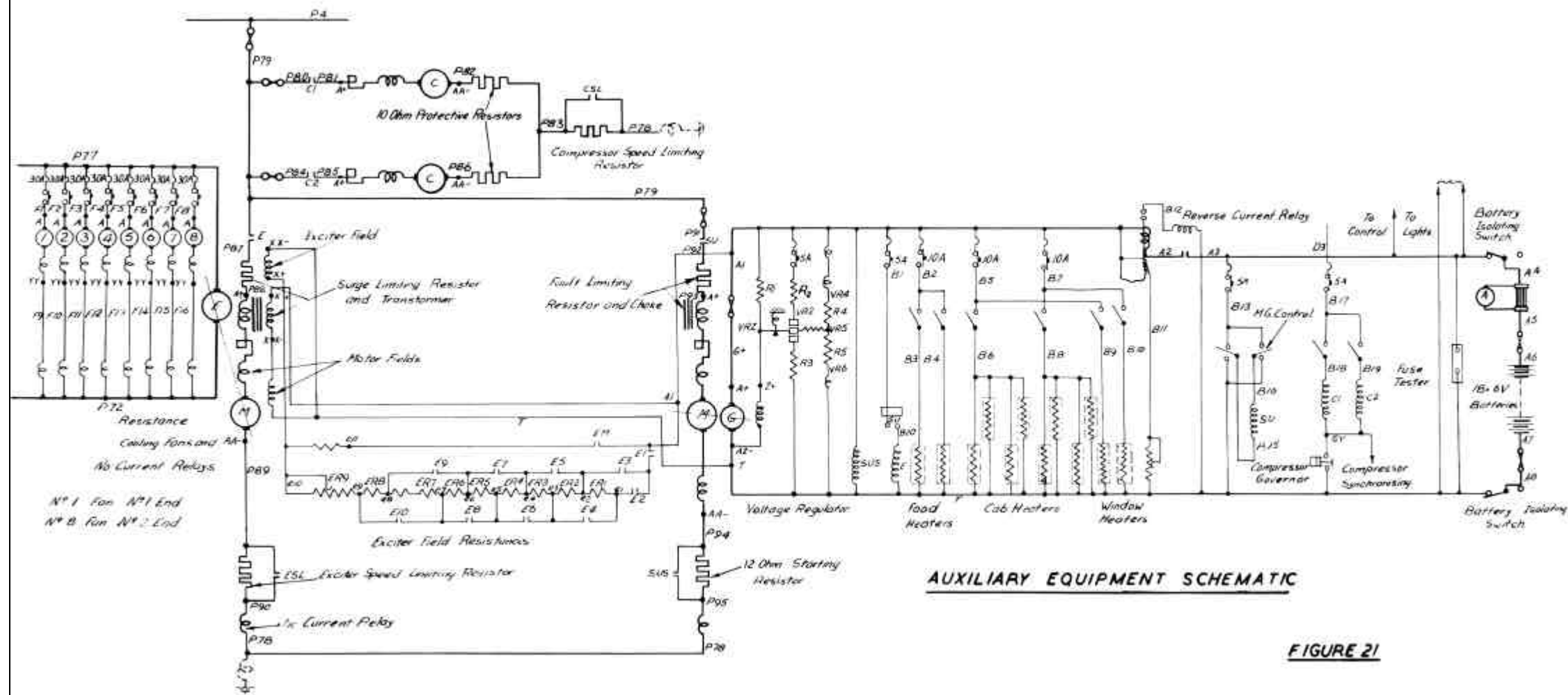
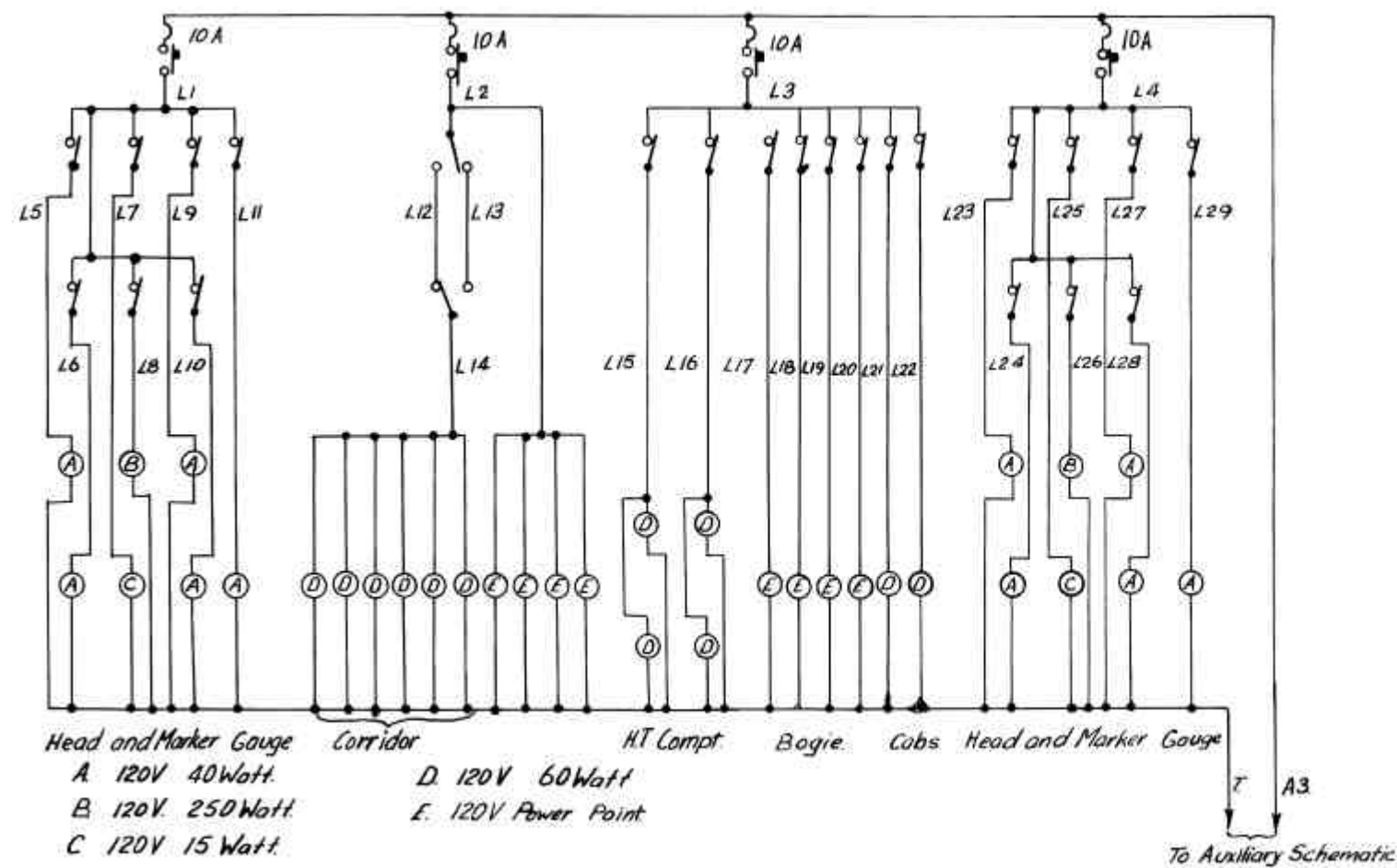


FIGURE 20
CONTROL SCHEMATIC PART 2





LIGHTING SCHEMATIC

FIGURE 22

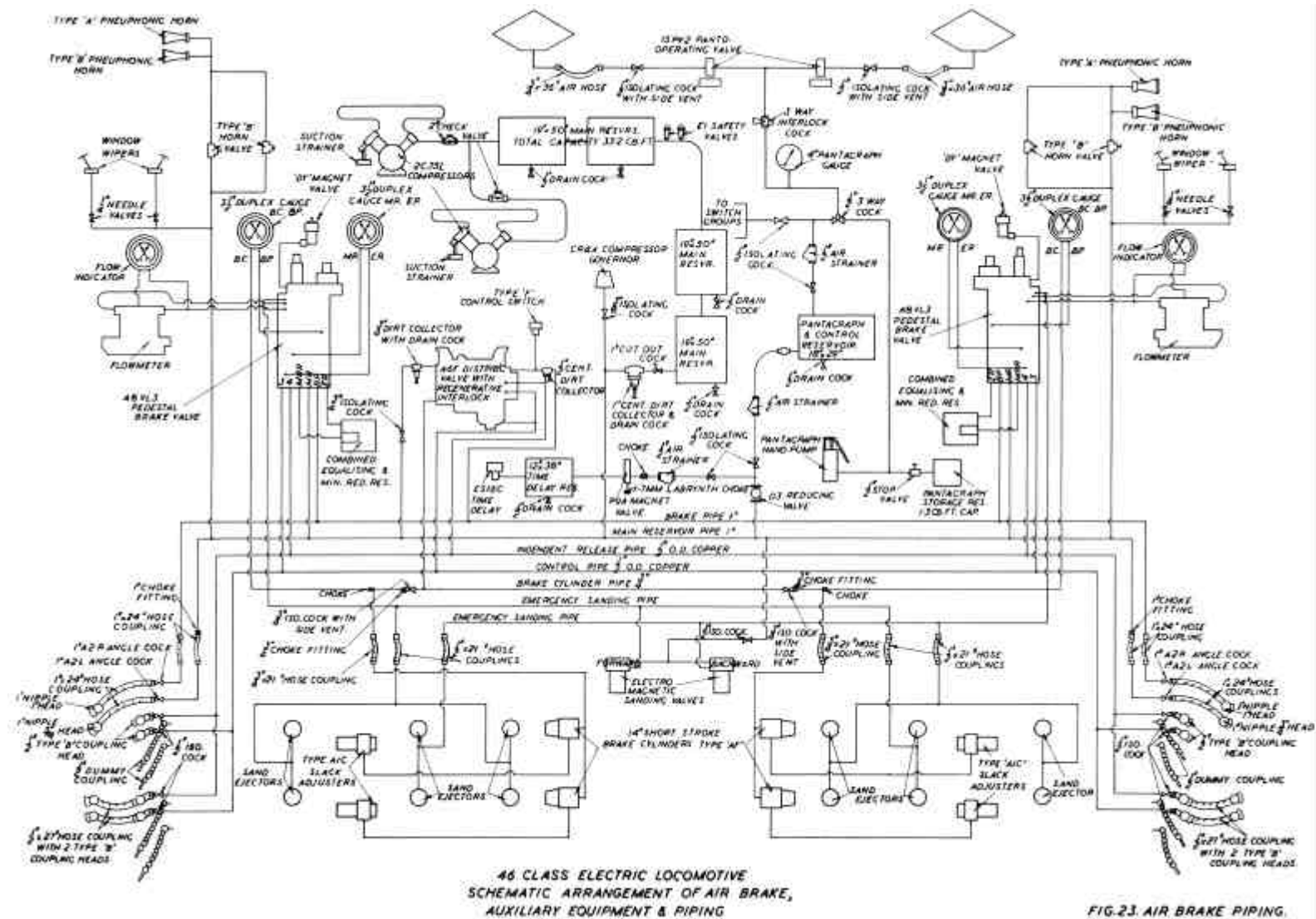


FIG. 23. AIR BRAKE PIPING.

20'-0" PHOTOGRAPHY & NIGHT LIGHT

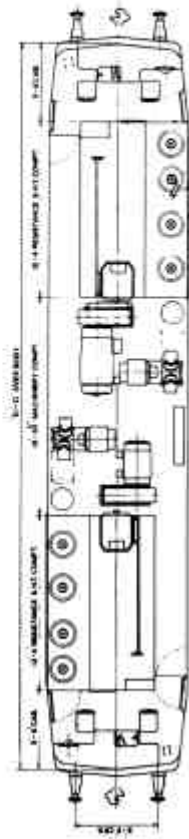
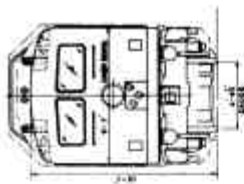
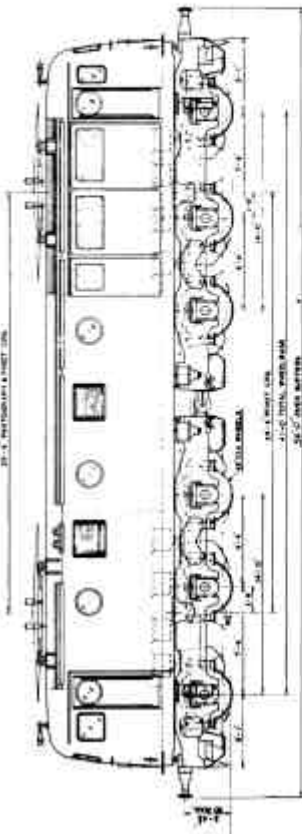


FIG. 24. LOCOMOTIVE DIAGRAM

AA VIGILANCE CONTROL

TROUBLESHOOTING

The following is a list of some of the faults that could occur in the Vigilance Control System.

Drawing Reference PL 11

Part 10 - Section 1.35

SYMPTOM	PROBABLE CAUSE	TEST	REMEDY
1. <u>Penalty Application With Audible Warning.</u>			
a) Indicator hand in green band at time of application.	Faulty Indicator	Operate Vigilance throughout its range noting operating pressures of the various valves and that the gauge movement is free. Check gauge against brake cylinder gauge (pressures stable) - should register 3-4 psi approx. less than brake cylinder pressure. Brake cylinder gauge should be tested against Standard test gauge.	If defective, change gauge allowable gauge error 2psi Hand of gauge may be set if less than 5 psi in error.
b) High timing volume pressure.	Magnet valve (No.3) permanently energised or not exhausting.	Check for blow of air from magnet valve exhaust port, if no blow turn off isolating switch to acknowledgment button, if blow is then present the trouble is electrical.	Electrician to locate and rectify defect.
c) Low timing volume pressure.	Magnet valve (No.3) not energising.	Make sure all switches in magnet valve circuit are correctly positioned. Depress magnet valve by hand, note if pressure rises, and that equipment functions correctly whilst magnet valve is manually operated.	Electrician to locate and rectify defect.
d) Trailing Unit (Audible warning on trailing unit).	Suppression valve DC.25 (No.2) not seating. or	Make a full independent brake application and energise magnet valve (No.3). If timing volume pressure increases continuously, suppression valve DC.25 (No.2) is not seating.	Change DC.25 suppression valve (No.2).
Note: Trouble experienced whilst a trailing unit.	Double check valve type BC (No.6) sticking. or piping defective.	Release brakes, close isolating cocks to both driver's brake valve pedestals, disconnect pipe from centre of double check valve (No.6), if no blow is present, check valve may be sticking or there is a piping defect. Test piping from drivers brake valve isolating cocks to the double check valve (No.6).	Clean double check valve (No.6). or repair piping.

Part 10 - Section 1.35

SYMPTOM	PROBABLE CAUSE	TEST	REMEDY
2. <u>Penalty Application</u> <u>Without Audible Warning</u>			
a. High timing volume pressure, Independent brake applied.	Independent brake application pressure too high.	Observe brake cylinder pressure, this pressure feeds into timing volume operating the valves in the vigilance if it becomes excessive. Pressure reducing valve may be set too high or defective (with A7 equipment) or the self-lapping portion of the B7 independent brake set too high or defective.	Reduce pressure change M3 pressure reducing valve or change B7 independent brake valve.
b. Indicator hand in green band.	Penalty valve DC.17 (No.10) not seating correctly.	Check for blow of air from 1/16" dia relief port at connection of C.13 check valve (No.11) to vigilance valve unit casting. If blow make a full independent brake application, blow will stop if DC.17 (No.10) valve is leaking through. Penalty applications should not take place whilst equipment is suppressed either by over 25 psi brake cylinder pressure or by both driver's brake valve isolating cocks being closed. If they do test for Symptom 1(d).	Change DC.17 valve.

Part 10 - Section 1.35

SYMPTOM	PROBABLE CAUSE	TEST	REMEDY
3. <u>Penalty Application Cannot Be Released</u>	Emergency Application Valve (No.16) off its seat.	Blow of air at Emergency Application Valve (No.16) exhaust will be evident. Clean emergency application valve, if trouble still persists check for blow at the exhaust of Snap Action Penalty Valve No.13.	Clean valve and examine 1/16" by-pass port, in Emergency Application Valve.
	<u>OR</u> Snap Action Penalty Valve (No.13) defective.	If a blow, reduce brake pipe pressure and note there is an exhaust from the brake pipe reset valve (No.15), if so the snap action penalty valve is defective.	Change snap action penalty valve.
	<u>OR</u> Brake pipe reset valve defective.	If no blow from exhaust of brake pipe reset valve, with brake pipe reduced below 25 psi, this valve is defective.	Change DC.25 brake pipe reset valve.
4. <u>Penalty Application Resets Without the Brake Pipe reduced below 25 psi</u>	Locking volume leakage.	Fully apply independent brake and test with soap, locking volume piping from C.13 check valves (No.11 and 12) to snap acting penalty valve (No.13) and brake pipe reset valve (No.15), not forgetting the exhaust port of this valve (brake pressure normal). Also check exhaust port at fitting between check valve (No.11) and unit casting.	Repair piping or clean check valve.
	Snap Action Penalty Valve (No.13) defective.	Test as above and at leakage exhaust port of snap action penalty valve.	Change snap action penalty valve.
	Check valve C.13- (No.12 not seating correctly).	Reduce timing volume pressure to operating pressure of DC.17 penalty application valve (No.10), if timing volume pressure then rises and falls about 2 psi check valve is defective.	Clean rubber valve or renew if badly marked.

Part 10 - Section 1.35

SYMPTOM	PROBABLE CAUSE	TEST	REMEDY
5. <u>Audible Warning</u> <u>Unobtainable (Gauge)</u> <u>Registered Correctly</u>			
a. High and low timing pressure.	Whistle faulty.	Allow indicator to enter red band and note blow of air at whistle	Change whistle.
	Defective piping to audible warning.	Allow indicator to enter red band, loosen connection on top of vigilance unit casting and note blow of air, tighten connection and test audible warning piping.	Repair pipework.
	Audible Warning Valve D.70 (No.8) defective.	Allow indicator to enter red band to high range, loosen connection on top of vigilance unit casting and if no blow is present D.70 valve (No.8) defective.	Change D.70 valve.
	Choke (C) blocked or DC.25 Audible warning valve (No.9) defective.	Allow indicator to enter red band in low range, loosen connection on top of vigilance unit casting and if no blow present remove DC.25 (No.9) audible warning valve and examine choke, if clear DC.25 is defective	Clear choke or change DC.25 valve.
6. <u>Audible Warning</u> <u>Continually Blowing</u>			
a. Brakes released and indicator hand in green band.	Audible warning valves D.70 (No.8) or DC.25 (No.9) not seating correctly.	Change DC.25 audible warning valve (No.9), if none available in store change with the brake pipe reset valve (No.15). If trouble still exists D.70 valve(No.8) is defective. If trouble is rectified the D.25 valve now on the brake pipe reset will have a blow of air at the exhaust port and it should be changed.	Change defective valve.

Part 10 - Section 1.35

SYMPTOM	PROBABLE CAUSE	TEST	REMEDY
6. <u>Audible Warning</u> <u>Continually Blowing</u>			
b. With independent brake applied.	Independent Brake pressure too low.	A full independent brake application should be 45 psi in the brake cylinders, if this is below 25 psi it will not seat the suppression valve (No.2) allowing the whistle to sound. If brake cylinder pressure is below 17 psi a penalty application will occur.	Rectify defect in brake equipment.
7. <u>Brake Cylinder Pressure</u> <u>Not Suppressing Equip-</u> <u>ment</u>	Bogie brake isolating cock closed or piping defective.	Observe brake cylinder gauge for the bogie under the No 1 cab, if no pressure registered bogie isolation cock is closed, or piping defective.	Open isolation cock or repair piping.
8. <u>Timing volume pressure</u>			
a. Falls rapidly when brakes released, magnet valve de-energised.	C.13 check valve (No.5) defective. AA System Check valve in check valve choke (No.24) defective.	Make a full independent brake application and release noting that timing volume pressure drops with brake cylinder pressure. Energise magnet valve and note exhaust from same, exhaust will be excessive if check valve defective.	Clean rubber valve, renew if badly marked. Clean rubber valve renew if valve badly marked.
b. Slow in charging or will not charge.	Piping defective (pipe leakage test).	Charge timing volume to 65 psi or as high as possible then apply independent brake and with magnet valve energised note leakage.	Repair pipework or clean rubber valve.

DEPARTMENT OF RAILWAYS : NEW SOUTH WALES
MECHANICAL BRANCH

46 CLASS ELECTRIC LOCOMOTIVES

GENERAL WORKING INSTRUCTIONS FOR FIREMEN – OBSERVERS

BY AUTHORITY

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CHIEF MECHANICAL ENGINEER

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INTRODUCTORY.

This manual, intended primarily for firemen-observers already employed on Electric locomotives, is also valuable to all employees in this classification as an introduction to a comparatively new locomotive type, the use of which will undoubtedly extend to other lines, in the near future.

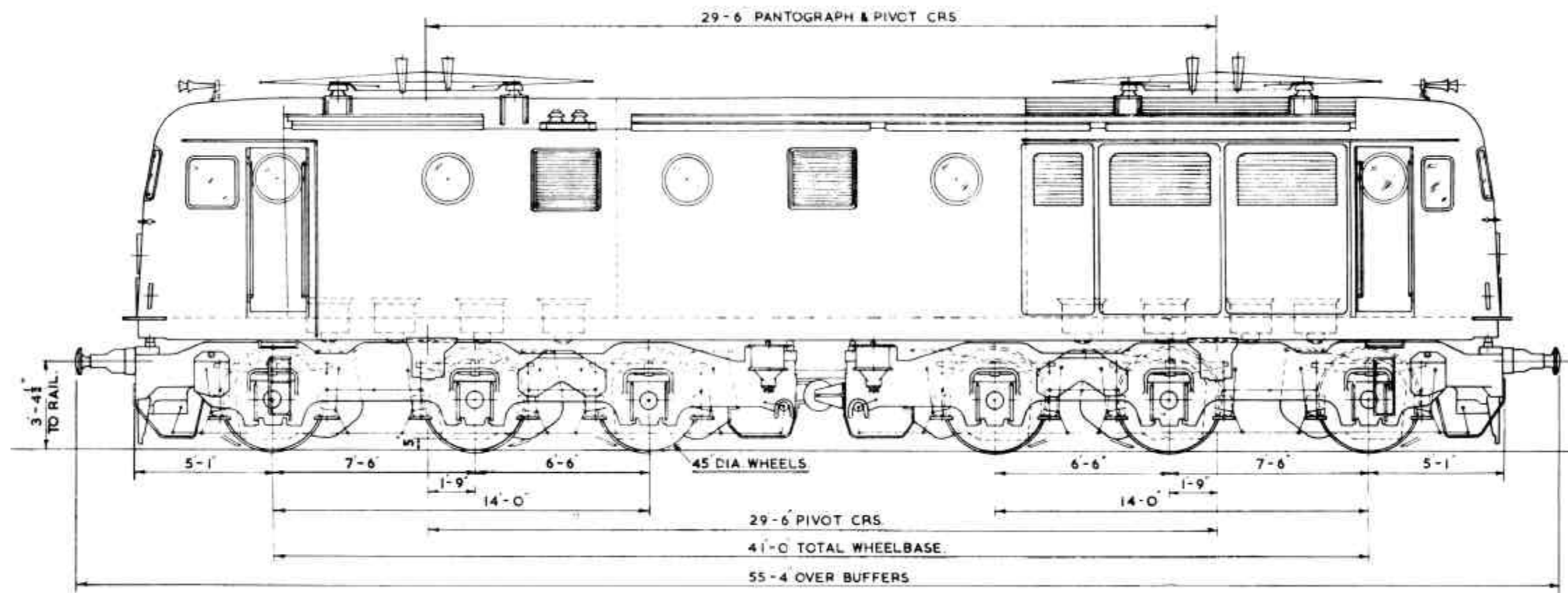
There is also the aspect that normal promotion and progression in the service will naturally bring the present fireman-observers to a point in their career where they must qualify for the more exacting duties of driving this locomotive type.

In this latter regard it should be appreciated that the present group of firemen observers is now being afforded an opportunity which was denied the present group of electric locomotive drivers in so far as, that the fireman-observer may gradually approach the subject and at the same time improve his grounding in the company of his driver.

This manual commences with an explanation of the duties and responsibilities of all firemen-observers currently employed.

Following this information a limited amount of fundamental knowledge of electricity is provided, and then in progression, are descriptive items of how electric current is controlled, routed and generally employed.

There is additionally available to all members of the Railways Institute a short informative course on 46 class locomotives, which deals in more detail with fundamentals, and the various circuits employed, together with the component machines and their functions.



INDEX.

- Item 1. List of preparation, stabling and emergency duties. Multiple unit working. Inspections.
- Item 2. Allowances, preparation, stabling.
- Item 3. Standard Examination Questions.
- Item 4. Electric current, its uses and the locations of High Tension current.
- Item 5. Circuits. Circuit breakers, Switches, Fuses.
- Item 6. Employment of High Tension (1,500 V) current on 46 class locomotives.
- Item 7. The control circuit, its origins and purpose.
- Item 8. Pantograph and Pantograph Control.
- Item 9. Air hoses on 46 class locomotives and their employment and spare hose. equipment to be carried.
- Item 10. Automatic alarms and safeguards.

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ITEM 1.LIST OF PREPARATION, STABLING, ROAD AND EMERGENCY DUTIES
TO BE PERFORMED BY FIREMEN WHEN EMPLOYED AS OBSERVERS ON
'46' CLASS ELECTRIC LOCOMOTIVES.PREPARATION DUTIES.

1. Unlock 4 doors, inspect kit and fire extinguishers and report to driver.
2. Test all marker and head lights each end and report to driver.
3. Tidy cabs, light hand lamps.
4. Stand by machinery compartment for pantograph raising.
5. Stand by driver in No. 1 Cab and test whistle and window wipers and observe pantograph reaction for driver.
6. Transfer control and brake valve handles to No. 2 end, set and apply independent brake, place other handles on desk.
7. Test wipers and horns and lift hand brakes No. 2 end, and observe pantograph reaction.
8. Set up head and tall marker and/or discs.
9. Pilot locomotive as required to Traffic points.

STABLING DUTIES.

1. Apply hand brakes each end and extinguish hand lamps.
2. Lock three (3) cab doors.
3. Charge storage reservoir and close inlet and outlet P. and C. reservoir isolating cocks.

ROAD DUTIES.

1. Share with the driver the responsibility for hand and all fixed signals, including right-away on driver's side and watching departure of train from platform.

2. To assist driver in changing ends by operating marker lights and/or discs at each end.
3. Operating hand brakes as required.
4. Attending to the correct coupling and uncoupling of the locomotive.
5. Operating of the locomotive in confined areas.
6. Attend any other duties as directed by the driver.
7. Regular inspections from each side of cab of the train details with particular attention to risk of hot axle boxes and dragging brakes.
8. 60" interval inspections of battery charging ammeter.
9. 30" interval inspections of auxiliary machines, etc.

FIREMEN'S DUTIES ON 46 CLASS ELECTRIC LOCOMOTIVES.

ITEM ONE.

The fireman of the 46 class electric locomotive being relieved of the activities of generating steam and associated duties is therefore in a position to give considerable practical assistance, not only in the normal course of train working, but to have the knowledge which will enable him to perform certain duties in emergencies.

PREPARATION.

The preparation of any locomotive is best achieved by following the same routine at all times. Any omission in the preparation then becomes obvious, therefore at all times commence the preparation in the No. 2 cab. The reason being the availability of the battery switch for illumination of the locomotive during darkness. No. 2 cab is always indicated by the high numbers on the axle boxes.

After entering No. 2 cab close the battery switch, check that the hand brake is on, check that the hand lamp is filled, and light if necessary, check that detonators and red flags are available, check that the pressure in the fire extinguisher is 100 p.s.i. and report any deficiency to the driver, switch on all

head and marker lights and observe their efficiency from the ground, being sure to again switch off unrequired lights to save battery drain.

In the corridor between No. 2 cab and the machinery compartment observe the presence of three multiple unit jumper couplings. They should be branded A, B and C. These couplings convey the low tension current from one locomotive to another in multiple working. Also in these corridors are:

Two small air hoses which connect the independent brake pipes of two or more locomotives.

One brake pipe end air hose, one main Reservoir pipe and air hose.

One sealed tool box. (If this seal is damaged or missing, report to driver).

In No. 1 cab make similar tests and inspect as in No. 2 cab.

Now remain in attendance to the driver so that in the machinery compartment, assistance may be given him in pantograph raising (initial) and in each cab, pantograph reaction to the driver's tests. While thus occupying each cab test the whistle valves and wind-screen wipers.

While the driver is carrying out ground level inspections, attend to correct targetting of the locomotive and stand by for hand brake adjustments and piloting of the locomotive as required.

DRIVERS, SPARE, AND EMERGENCY EQUIPMENT.

The following equipment shall be carried in each 46 class electric locomotive:-

DRIVERS EQUIPMENT.

- 2 Hand lamps. One in each driver's cabin.
- 1 Tail disc. In No. 1 cabin.
- 2 cases of 12 Detonators. One in each cabin.
- 2 Red flags (in flag cases). One in each cabin.

FOR COUPLING TO ANOTHER LOCOMOTIVE.

- 2 1/2" hose couplings. In No.2 End Corridor.
- 3 Jumper couplings. In No.2 End Corridor.

TOOLS.

1 Spanner, hose M.R. & T.L.)	(T.L.= B.P.)
" " Bogie M.R.)	
" " B.Cyl.)	
" " Sand)	In sealed box in
1 Pin punch 3/8")	No. 1 end corridor.
1 Chisel)	
1 Hammer)	
1 Inspection light and lead)	

SPARE & EMERGENCY EQUIPMENT.

1 Air hose M.R. 3/4")	
1 " " T.L. 1")	
1 " " B.Cyl. 1")	
1 " " Sand 1/2")	In open box in
1 Rope, 40 ft.)	No.1 end
1 Light globe, headlight 250W.)	corridor.
2 " " interior 60W.)	
2 " " marker 40W.)	
2 " " pilot 15W.)	
2 Fuses, Main Aux. H.T. 150A.)	In rack in No.1
	H.T. Compt.
2 " Gen. H.T. 50A.)	In rack in No.1
	H.T. Compt.
2 " Comp. H.T. 18A.)	In rack in No.1
	H.T. Compt.
1 Fuse Spanner.	
2 " L.T. Gen. & Battery)	On bottom of L.T.
	Panel No. 2 end.

Spent H.T. fuses to be placed in box in No. 1
H.T. Compartment.

Spent L.T. fuses to be placed in bottom of No.2
L.T. Panel.

1 Hook stick	In No. 1 End Corridor.
3 Fire Extinguishers	One in each cabin and centre compartment.

STABLING DUTIES.

Between the point of Traffic Release and the stabling site it is the requirement of the fireman-observer to pilot the movement as directed by the driver.

The principal hazards usually are, opposing or converging movements of other locomotives.

Facing points and converging roads also require close inspections.

If at any point a "Road not wired" symbol is located, be sure to stop the locomotive until it is ascertained that the route intended is wired.

This symbol is a yellow coloured reflector board with a pantograph outline (Black) in centre.

If a Siding to be entered has its overhead wiring controlled by a local switch, stop the locomotive and confer with the driver.

Section Insulators at Loco Repair Roads must never be encroached upon, except on authority of the Depot Officer.

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ITEM 1.STABLING DUTIES.

After arrival at the stabling site, apply both hand brakes, each brake catches only the related bogie.

Close all cab windows, lock three doors.

Extinguish and stow hand lamp.

Inform the driver of all noted defects on the locomotive for entry in the log book.

In the machinery compartment, after the pantographs have been lowered, turn the pantograph control three way cock so that the handle points down. This directs air from the pantograph and control reservoir towards the air Storage Reservoir.

Open the Storage Reservoir air valve for one minute to allow air to store, then close the air valve firmly.

Next close the inlet and outlet cocks to the pantograph and control reservoir to isolate and conserve the compressed air contained therein.

Lock the fourth cab door after egress.

ORDINARY ROAD DUTIES.

The altered speed at which Electric locomotives perform their work causes a much faster starting rate, and train running rate, than any other locomotive type operated and because of these factors the attention of the driver is at times fully taxed.

It is essential that the fireman-observer should fully co-operate with his driver in the matter of fixed and hand signals obedience by calling the indications to the driver as required.

Hand signals from Traffic Branch employees at stations and sidings are to be promptly received, acknowledged and conveyed to the driver.

Careful observance of passenger trains departing from platforms must be made from each side of the cab, as required, by the fireman-observer.

Level crossing risks are to be safeguarded by close scrutiny at all times and further by locomotive whistle where the gates at these are not interlocked with the signals.

The exhibition of a Way and Works Branch yellow flag, red flag or Warning Board, or whistle sign, and the explosion of detonators on the track also calls for an immediate sounding of the whistle and extra vigilance.

Firemen-observers should always consult the Weekly Speed Notice before a journey and will thus be able to anticipate Way and Works Branch requirements and also regulate their routine inspections to suit. At signal stops where the Signal Telephone is to be used, drivers switch off the Supply Motor Generator to reduce noise during conversation; on return to the cab the fireman-observer should note that the Supply Motor Generator is again switched on.

En route, the fireman-observer is required to regularly inspect the cars and wagons comprising the train from both sides of the cab.

Due to the powerful locomotive employed, brake drag or even a derailed vehicle would not be detected by speed drop nearly so quickly as with other locomotive types.

Under certain circumstances also hot axle boxes are more likely to develop due to the overall higher train speed rates.

Hot axle boxes may cause broken axles. Broken axles always cause derailment, serious damage to wagons and consignments for which your employer is responsible.

With broken axle derailments there is always a strong tendency to fouling the opposite track on double lines.

In summary therefore watch the train for blue (oil) smoke.

When in doubt consult the driver.

CHANGING ENDS OF THE LOCOMOTIVE IN TRAIN WORKING.

Where a reversal of locomotive movement is required, at any turn around point in train working or light engine movements, it is required that the crew should transfer the controls to the altered leading end of the locomotive.

The Driver is required to isolate the controls at the end being vacated and set up control at the opposite end.

The fireman-observer is required to close up the cab openings at the end being vacated and in the case of further train working or light engine running attend to the necessary alterations to front end and rear end targetting of the locomotive.

COUPLING AND UNCOUPLING OF THE LOCOMOTIVE.

The driver is always responsible for the manner in which a locomotive is coupled, or uncoupled, from any train.

The fireman-observer, when required to attend to these details should observe the following procedure:-

- (a) Select the side to work on, to provide for being in the best range of vision of the driver.
- (b) Keep clear of adjacent running lines.
- (c) If necessary, stop the locomotive short of the train until auto coupler jaws, transition chains and end air hoses are correctly positioned.
- (d) Coupling auto coupler to auto coupler, observe that both coupler locks drop to the locking position, and insert safety catches where provided on locomotives.
- (e) Coupling the auto coupler transition chain to a drawhook, ensure that the auto coupler jaw is fully opened.

Where regulations require it, threadle the transition chain with a covering chain.

- (f) On all occasions, most particularly where the leading vehicle has a diaphragm buffer, stand outside the buffers until contact is made and motion has ceased.

In uncoupling either from an auto coupler or a drawhook:

- (a) Close both end air taps; separate the end air hoses; discharge air from the train and stand outside the buffers to hand-signal the ease up requirement for opening auto jaws or lifting the transition chain.
- (b) Hand-signal the locomotive away from the train before targetting train and locomotive and hooking up the locomotive air hose.

MULTIPLE UNIT WORKING.

Assembling or dividing two locomotives.

It is the duty of both firemen-observers to carry out these duties together, where each locomotive is manned. It is the duty of the driver of the rear locomotive to supervise these activities.

Care should be taken to ensure that A.B. & C. control jumpers and Nos. 3 and 4 Westinghouse control jumpers are always stowed after use on the locomotive which provided them.

COUPLING TWO LOCOMOTIVES FOR MULTIPLE UNIT WORKING.

- (a) Prepare auto coupler jaws, Brake pipe and main reservoir end air hoses.
- (b) After coupling up, test the auto coupler locks and insert the Safety Catches.
- (c) Couple Brake pipe air hoses and main reservoir air hoses and open the four associated air cocks.
- (d) Couple the No. 3 and 4 Westinghouse Control air hoses and open the associated four air cocks.
- (e) Insert and force fully home the B.C. & A. control jumpers in the corresponding jumper sockets and in the order of B.C. and A.
- (f) Extinguish marker lights between locomotives.

UNCOUPLING TWO LOCOMOTIVES.

- (a) Remove Control jumpers A.C.B. in that order.
- (b) Remove Westinghouse Control Nos. 3 and 4 jumpers, close cocks.
- (c) Stow all control jumpers in the correct locomotive.
- (d) Close Brake pipe and main reservoir end air hose cocks and divide hoses.
- (e) Uncouple auto couplers, signal the front locomotive clear, hook up end air hoses and adjust marker lights.

INSPECTIONS.

At regular intervals of about 60", unless some abnormal condition exists, it is a requirement of the fireman-observer to select sites where fixed signals are not located to inspect the Machinery Compartment details and the low tension cabinet (No. 2 cab).

In the machinery compartment there are four Auxiliary machines which are driven by four separate high tension motors.

Overheating signs of any of these should be carefully checked and reported on.

On each compressor there is a lubrication oil vapour discharge vent.

It is a normal function that a minor amount of vapour should be discharged.

Elsewhere any smoke should be treated as a defect and reported on.

In two separate cabinets in this compartment there are housed a total of eight thermal type circuit breakers which control current flow to the Resistance Fan motors.

Unless a continuous yellow light shines in the cab it may be assumed that the circuit breakers have not tripped.

The Pantograph and Control air pressure gauge should show at least 70. P.S.I.

ITEM 1.EMERGENCY DUTIES.FIRES ON ELECTRIC LOCOMOTIVES.

Three (3) fire extinguishers, each with a minimum pressure of 100 P.S.I. are carried on all 46 class locomotives, one in each cab and one in the machinery compartment.

It is the duty of the fireman-observer to use this equipment as required.

The extinguishers are portable and should be carried to the fire site, upright.

Point the nozzle of the flexible hose to the base of the fire and operate the wheel valve.

Each use must be recorded in the locomotive log book.

LOCOMOTIVE ROOF FIRES.

To gain sufficient height to deal with these, do not rise above head level with the locomotive roof, and both pantographs should be lowered whilst the fire is being dealt with.

Before any fire is dealt with, current must be cut off from the circuit on fire.

To disconnect high tension current from the locomotive, the both pantographs must be lowered.

To disconnect low tension current within the locomotive the Supply Motor Generator must be switched off and the Battery Switch opened.

Remember that in each of these cases the Westinghouse air Brake Compressors will not run and security of the train must be considered accordingly.

SECURITY OF TRAINS ON HEAVY GRADIENTS WHERE THE WESTINGHOUSE BRAKE AIR COMPRESSORS HAVE FAILED.

On a direction from the driver to carry out this duty, the fireman is to immediately proceed along the Cess side of the train, applying the hand brakes on every vehicle, or to that point where he meets the guard and has his assurance that the remainder of the brakes have been applied.

In addition the requirement is to sprag the six (6) vehicles at that end of the train indicated by the falling gradient.

Any message from the driver to the guard should be accurately given and the fireman-observer is then to return promptly to the driver unless otherwise directed.

Where it is a further requirement of the fireman-observer to proceed to a Block Station or Signal Telephone to obtain assistance or relief locomotive, he should ensure that he carries the correct safe working form, accurately filled in and addressed, a red flag, lighted handlamp and the canister of detonators.

APPLICATION OF THE INDEPENDENT WESTINGHOUSE AIR BRAKE
AND THE AUTOMATIC AIR BRAKE ON 46 CLASS LOCOMOTIVES.

During preparation duties and to meet the emergency of a driver being incapacitated on the main line the fireman-observer is required to apply the Independent brake.

This Brake valve has five operating positions viz. (from left to right movement of the handle):

- (1) Fast release.
- (2) Running position (and slow release).
- (3) Lap (or holding).
- (4) Slow application.
- (5) Fast application.

On any occasion where the fireman-observer uses this brake it should be placed and left in either No.4 or No.5 positions to ensure continuous holding of the brake.

The Red pointer of the duplex air gauge registers the air pressure being applied. This is limited to 45 P.S.I.

On the main line, if the driver should become incapacitated, the fireman-observer is required to bring the train to a stand and hold it thus.

Following this action he is required further to bring the guard forward to assist him to handle the situation.

The fireman-observer should avoid leaving the locomotive for this purpose.

The whistle or hand signal or use of any messenger available should be availed of to bring the guard forward.

To bring the train to a stand the throttle (accelerating handle) should be moved to the 'off' position and the automatic brake valve moved to service application position to reduce the brake pipe pressure by 25 P.S.I.

The brake valve handle should then be placed at the "lap" position to hold all brakes applied.

The brake pipe pressure is shown on the black pointer on each of the two duplex air gauges.

The automatic brake valve handle has five (5) positions which are: (from left to right).

- (1) Full Release.
- (2) Release and Running position.
- (3) Lap (or holding position).
- (4) Service application position.
- (5) Emergency application position.

CUTTING OFF CURRENT FEED TO THE TRACTION MOTORS.

This emergency action requirement of the fireman-observer is also necessary, just as is the closing of the throttle of the steam locomotive.

The accelerating handle (throttle) is the middle lever of the three positioned at the driver's station.

It has twenty (20) notches of graduation between the fully closed and the fully open position.

It is opened (to permit current feed to the traction motors) by moving it, one notch at a time, towards the driver's station.

It may be closed (thus cutting off current feed to the traction motors) by moving it fully forward (away from the driver's station).

Care must be taken not to hold in the transition plunger at the end of the accelerating handle, as this purposely prevents the fully closing of throttle.

The two gauges marked Ammeters should be observed and each should indicate zero if the throttle has been correctly closed.

If due to any cause, the accelerating handle (throttle) cannot be closed, the current feed to the traction motors may be effectively cut off by simply turning the control key to the "off" position.

Immediately the control key is turned to "off" the line switches open and disconnect current feed to the traction motors and the red lamp shines to indicate this event.

The control key should then be turned to "on" again and left in that position.

This action will not permit current to again be fed to the traction motors, but will restore current feed to the air compressor motors, thus ensuring Westinghouse Brake control of the train.

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ITEM 2.

In cases where it is necessary to prepare or stable two '46' class Electric locomotives working in multiple the following allowances are to apply:

PREPARATION.

Driver	50"	(40" for preparation of units,
Fireman	50"	20" for each locomotive. 10"
		to obtain jumper coupling
		assemble the two units and
		carry out necessary tests).

STABLING.

Driver	20"	(10" uncouple units and stow
Fireman	20"	jumper coupling. 10" to stable
		locomotives, 5" for each unit.

Any approved walking times and signing on or off duty allowances are to be added to the above.

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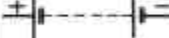

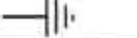
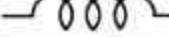



ITEM 3.STANDARD EXAMINATION QUESTIONS.

Practical conversion course for locomotive firemen, Steam or Diesel-Electric locomotives, to Electric locomotives, is applied by one shift of instruction on a stationary 46 class locomotive. Hereunder is the standard examination.

'46' CLASS LOCOMOTIVE FIREMANS' EXAMINATION

1. What is the purpose of the Storage Reservoir?
2. What is the alternative supply of air if the storage reservoir is empty?
3. What is the procedure to fill the storage reservoir?
4. How is air obtained from the storage reservoir for pantograph raising?
5. What is the normal position for the three way pantograph control cocks?
6. How many fire extinguishers are there and what is the regulation pressure in each?
7. What is the correct method of operating the fire extinguishers?
8. What are the fireman's duties regarding pantograph reaction?
9. Where is the high tension current located on the locomotive?
10. In the event of a compressor failure and/or an overhead supply failure on a heavy falling grade what are the regulations for securing the train?
11. What is the holding position for the independent brake?
12. What is the routine associated with a service application of the automatic brake?
13. How may the power be cut off to the traction motors and still be retained to the compressors etc?

In order to assist the student in tracing electric current paths the following symbols are presented together with appropriate explanation.

SYMBOL	ELECTRICAL DEVICES.
+ or +ve	Positive
- or -ve	Negative
	Air Break Switch (open)
	Fuse
	Circuit Breaker (open)
	Conductor or wire
	Conductors crossing and not connected.
	Conductors crossing and connected (Junction)
	Voltmeter
	Ammeter
	Generator
	Motor
	Battery
	Unit switch
	Earth connection or rail return to sub-station
	Field winding or electro-magnet coil.
	Reverser
	Resistance unit or rheostat.
	Ammeter shunt. (Sometimes used as ammeter symbol.)

14. Where are the Rheostats fan motors circuit breakers located?
15. How many of these circuit breakers are there and how may they be reset?
16. Where is the location of the low tension panels of miniature circuit breakers and which are the most important of these?
17. What is the correct order for M.U. Jumper Couplings and air hoses when coupling to another 46 class locomotive?
18. What are the fireman's duties regarding the grade control valves at Valley Heights on the Up journey?
19. State the fireman (a) preparation duties (b) stabling duties (c) road duties. (Including coupling and uncoupling of locomotives in Multiple Unit working).

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The foregoing examination represents the basic standard requirement.

It is quite reasonably expected of firemen-observers employed on electric locomotives, that due to opportunities now presented, they should progressively improve their knowledge of the locomotive parts and functions and train working. To this end observation of the driver's activities and discussions with him is one very good method.

Locomotive Running Inspectors necessarily have an expert knowledge of all of the associated matter and firemen-observers should never hesitate to take advantage of this source of instruction and information, when present.

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ITEM 4.ELECTRIC CURRENT. ITS ORIGIN AND USE.

Just as steam is the invisible agent to which pressure is applied in order to drive a steam locomotive so is current the invisible agent to which pressure is applied in order to drive an electric or diesel-electric locomotive.

Electric current is measured in amperes and a gauge termed an ammeter is employed in electric circuits to show just what volume of current is being fed to a circuit.

Before current may flow through a circuit two conditions must always be provided, they are:

(a) A complete circuit or path must be provided from the source of supply, through a resistance and back to the source of supply.

This source of supply takes the form of a Generator or a Storage Battery.

(b) A pressure which is usually called Voltage or Electromotive Force, must be made available to push the current through the circuit.

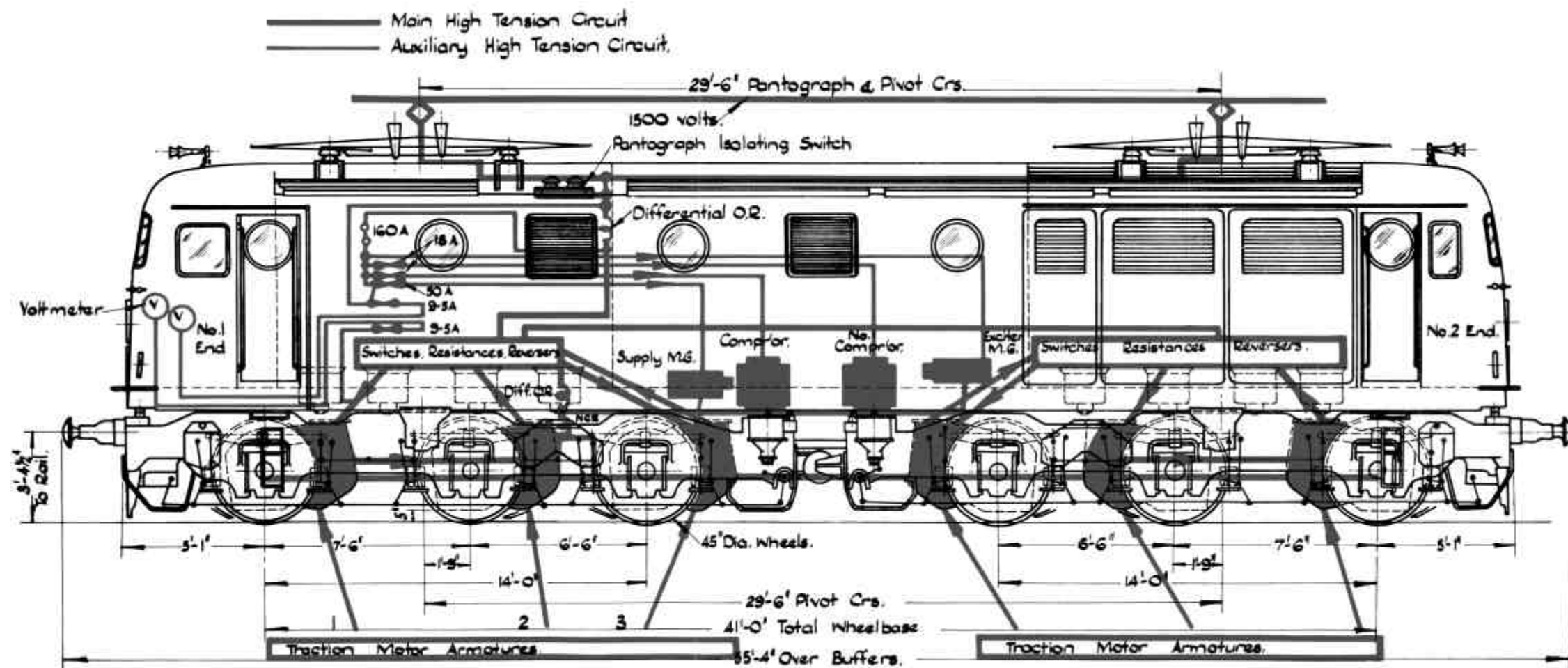
A Voltmeter is a gauge which measures the voltage or pressure which is available to push current through a circuit.

Therefore, the higher the voltage available, the greater is the amount of current which may be pushed through the circuit.

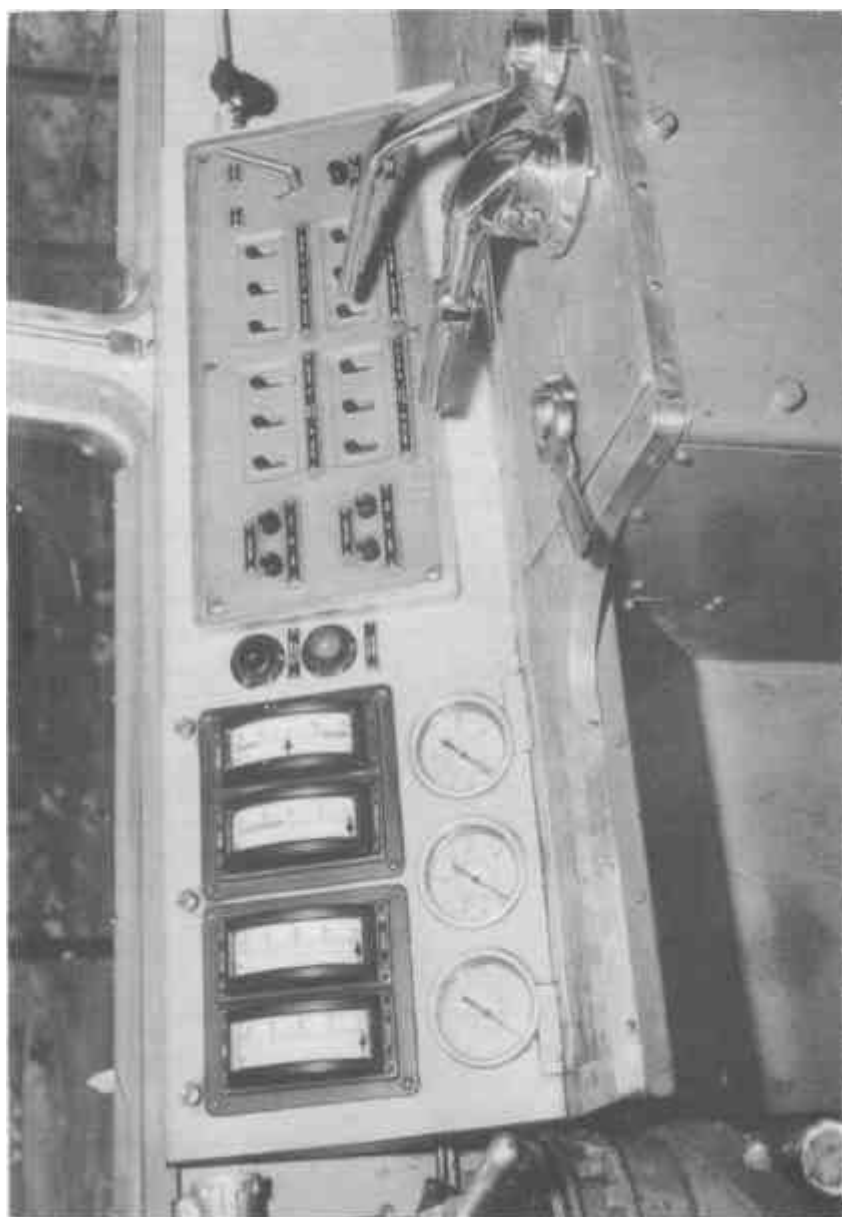
On a Diesel-Electric locomotive the Diesel Engine is used to drive a Generator of suitable size thus providing the voltage or pressure necessary to push current via cables and contactors to the traction motors.

On an Electric locomotive voltage or pressure is obtained from the overhead wiring to push current via cables and contactors to the traction motors.

At the associated power houses, diesel engines, coal fired boilers and sometimes the force of falling water is used to drive Generators of suitable capacity and these prime-movers feed and maintain the voltage or pressure in the overhead wiring.



MAIN AND AUXILIARY HIGH TENSION CIRCUITS.



DRIVER'S CONTROL PANEL.

The voltage or pressure which is maintained in the overhead wiring for the use by Electric locomotives and Electric trains is maintained at about 1,500 volts.

Under certain circumstances this line voltage may vary up or down by two or three hundred volts, but at all times it is regarded as High Voltage or High Tension current and great care is necessary to avoid the risk of human contact with it in that location or any connections to it within or about the locomotive.

Remember well also that most metals and an unbroken jet of water will act as conductors of this current.

The following items are considered to be High Tension equipment:

The pantographs and connections and all roof rigging.

All equipment housed in both Nos. 1 and 2 High Tension compartments.

The voltmeters in each cab.

The motors which drive the four auxiliary machines and the associated cable connections.

The six traction motors and the cable connections.

All of this equipment is reasonably well secured against human contact.

To disconnect High Tension current from any locomotive lower the pantographs and isolate them by closing the respective isolating cocks.

If the pantograph cannot be lowered, use the hooked stick to open both pantograph switches.

It must never be assumed that any pantograph has moved in either direction without visual inspection.

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ITEM 5.CIRCUITS. CIRCUIT BREAKERS, SWITCHES, FUSES.

An electrical circuit may be described as the path through which current is caused to flow, together with the source of supply of current flow, (usually a generator or storage battery), the equipment being operated, the fuses which protect the circuit, and, the switches and circuit breakers which control the current flow.

A closed circuit is a complete circuit where current flows through the items described above.

An open circuit is a potential circuit as described but where due to some break in the total path, current cannot flow.

Since one of the essentials for current to flow is a complete circuit, the opening of a switch or circuit breaker, or the burning out of a fuse, will cause an open circuit.

A switch or circuit breaker may therefore be described as an item employed to provide for the control of current flow.

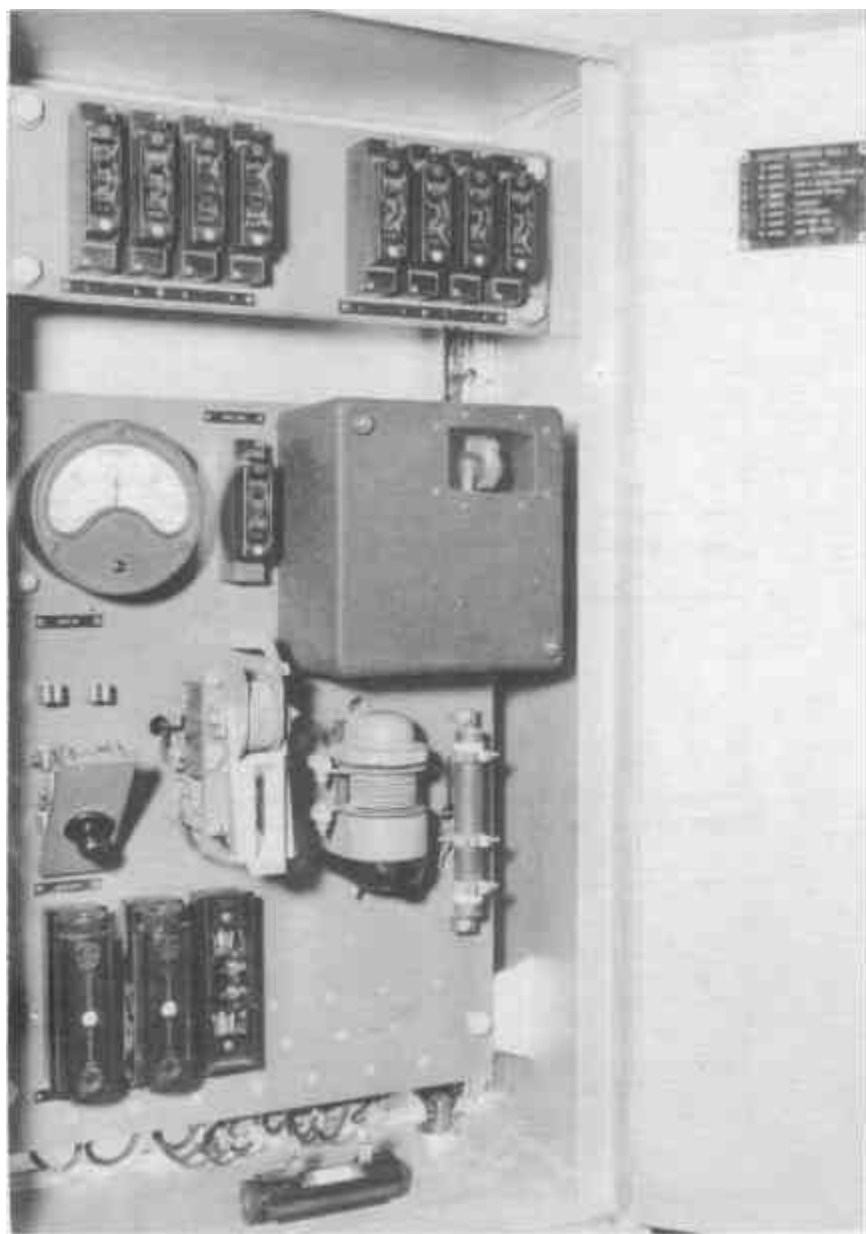
A fuse is a safety device placed in a circuit to protect that circuit from a harmful surge of current.

The action of a fuse is therefore to automatically open the circuit and prevent further current flow, where a harmfully high current surge is present.

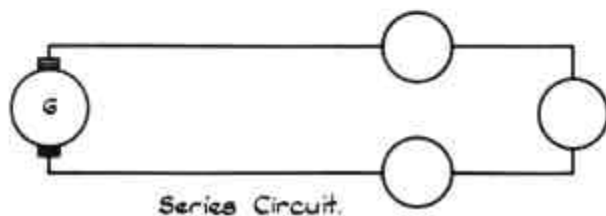
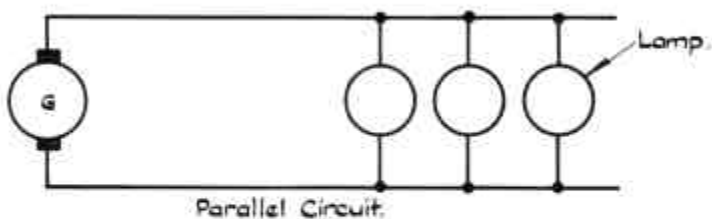
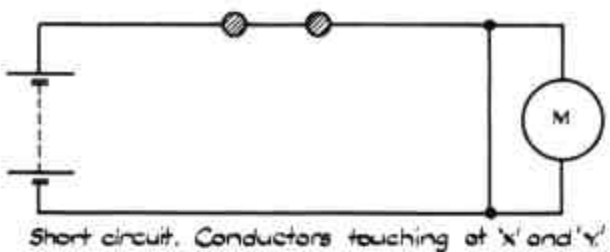
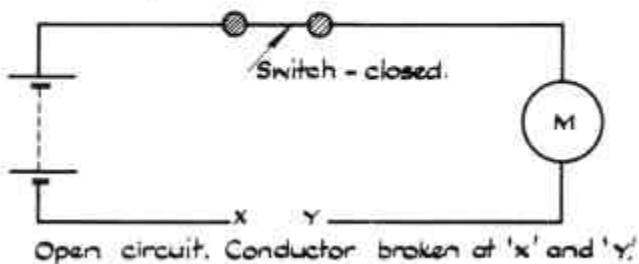
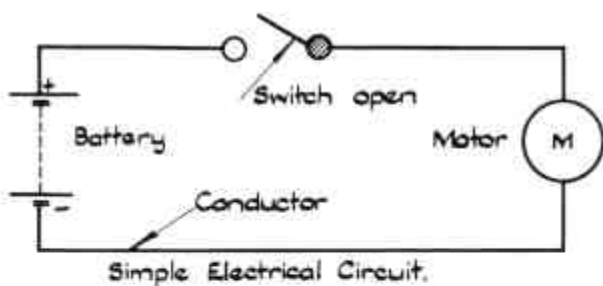
With the cartridge type fuse a strip of conducting wire of some predetermined fusing value is used. Thus, where current surge appears, the fuse wire fuses or burns, thus becoming broken and disconnecting the circuit.

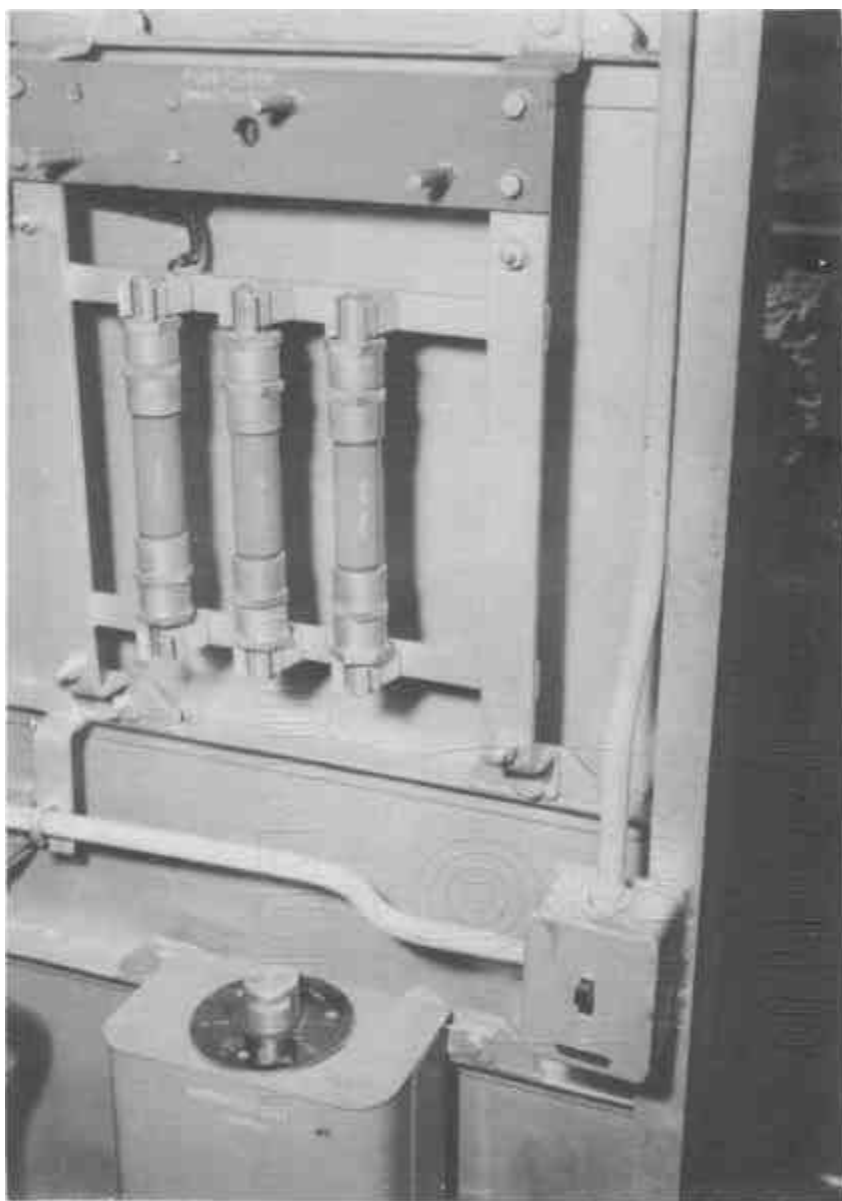
On a 46 class locomotive there are nine cartridge type fuses employed in the various circuits.

In the auxiliary High Tension circuit there are:
One 160 ampere fuse which protects the auxiliary circuit.
one 50 ampere fuse which protects the supply generator motor.
two 18 ampere fuses which respectively protect the two compressor motors.
two 9.5 ampere fuses which protect the four voltmeters.

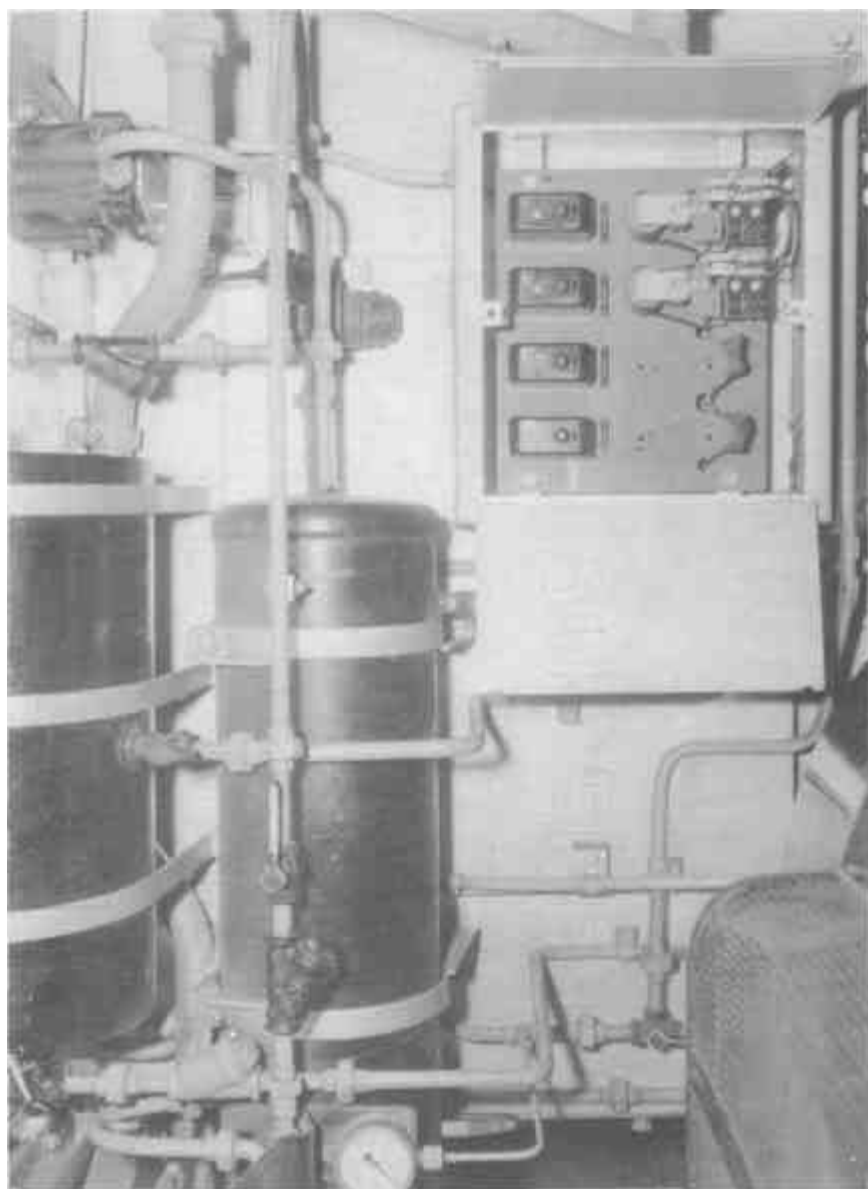


LOW TENSION PANEL : NO. 2 END.





FUSE TEST PANEL, SPARE FUSES AND MOTOR CUT-OUT SWITCH.



RESISTANCE FAN MOTOR MINIATURE CIRCUIT BREAKERS
AND FAN TIME DELAY RESERVOIR.

In the low tension circuit there are three fuses, these are:

The 100 ampere Supply Generator fuse which protects the control circuit.

The 100 ampere Battery positive fuse and the 100 ampere Battery negative fuse which protect the batteries.

Before any fuse in any circuit is handled for any reason, including renewal, the corresponding circuit must be isolated by opening the controlling circuit breaker.

The very good reason for this precaution is that whilst a burnt out fuse has automatically disconnected the original circuit, contact with the hand may provide a new and shorter path or circuit through the human body.

There is another protective device employed in low tension circuits termed a thermal circuit breaker. This item is a circuit breaker which has an inbuilt thermal strip which reacts like a fuse in so far as that if a harmful current surge appears the thermal strip relaxes and trips the circuit breaker open, thus opening the circuit.

Unlike the cartridge type fuse, renewal is not necessary. Allow the thermal strip a short time to cool off, then reset the switch.

Never hold a thermal circuit breaker at the "on" position. This would defeat its purpose.

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ITEM 5.MAGNETIC TYPE SWITCHES AND ELECTRO-PNEUMATIC TYPE CONTACTORS.

These two devices, since they are basically switches, are employed on the 46 class locomotive to connect or disconnect or vary the route of current flow.

As these are employed in the High Tension circuit, it is necessary that they be remotely controlled in the opening and closing actions.

Examples of the magnetic type switches are the two contactors which apply and disconnect the high tension current feed to the two air compressor motors.

Examples of the Electro-pneumatic type contactors are the six line switches and the Starting Resistance contactors.

All of these are necessarily housed in the high tension compartments of the locomotive.

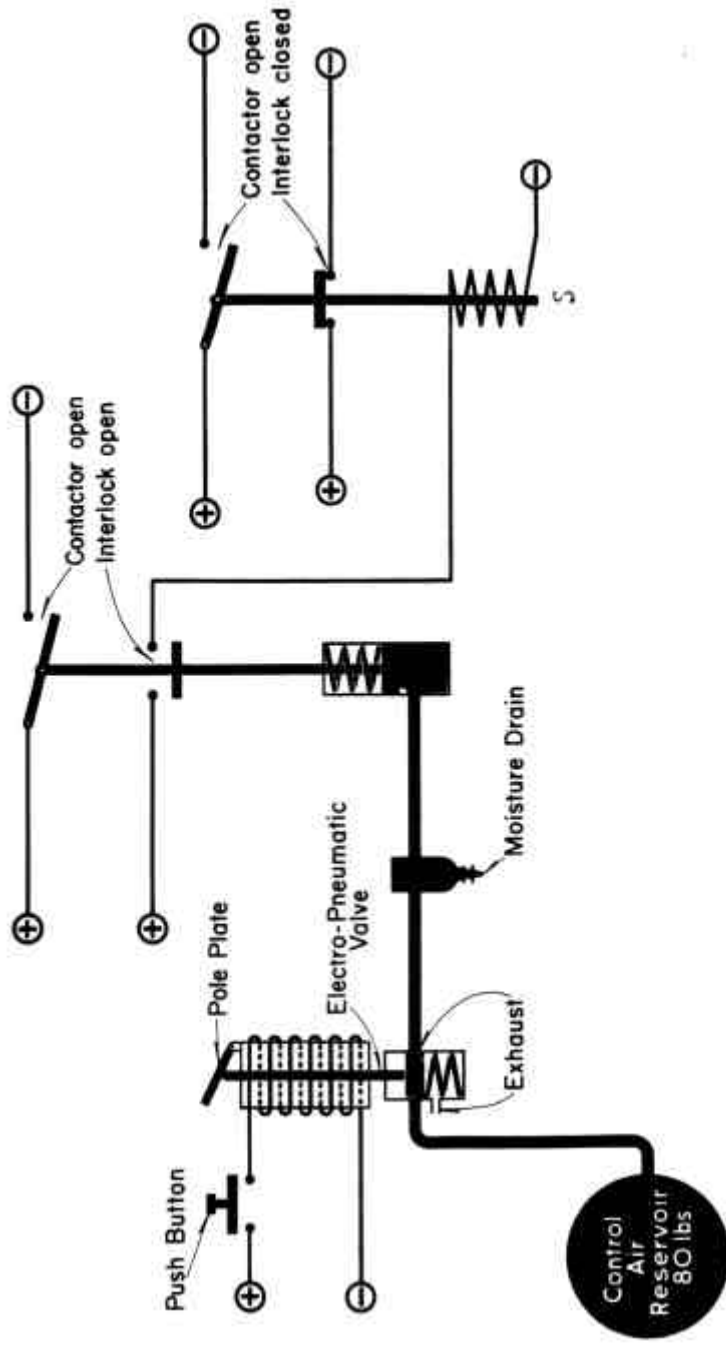
Each of these types relies on the principle of a temporary magnet to close them and hold them closed, and a spring which opens them when the temporary magnetism is destroyed.

The closing of the contactor faces connects the high tension current, and the opening of the faces disconnects the high tension current.

With the magnetic type switch, a Solenoid coil is fixed to one of the arms of the contactor.

Control current (from the supply motor generator or the storage batteries) is used to energise the coil, which now becomes magnetised and thus attracts and holds the second arm of the contactors.

With the electro-pneumatic type contactors, the Solenoid is used as a temporary magnet to control the passage of compressed air (Pantograph and Control Reservoir air) to a small air cylinder.



BASIC ELECTRO-PNEUMATIC AND ELECTRO-MAGNETIC CONTACTORS AND INTERLOCKS

The piston in the cylinder is linked to a moving contactor arm.

The thrust of the air piston forces together and holds the contactor faces, thus permitting current to flow.

When control current is switched off to the Solenoid, the magnetism disappears.

A spring reverses the control air valve, which cuts off control air flow to the air piston and exhausts the air from the air piston.

A spring now forces the air piston back and the contactor faces are parted, thus cutting off the flow of high tension current.

In summary therefore, to operate either a magnetic type switch, or an electro-pneumatic contactor, to control the flow of high tension current, a low tension control circuit is necessary to operate the solenoid coil.

Control current (120 volt) is supplied by the supply motor generator or the nest of storage batteries.

To operate an electro-pneumatic contactor, in addition to control current, to operate the Solenoid, control air pressure is required to operate the contactor air piston.

The electro-pneumatic arrangement is often referred to as a magnet valve.

When the magnet valve is attached directly to the high tension contactor, this is termed a Unit Switch.

Since the unit switches are housed together in high tension compartments of the locomotive, they are referred to as Switch Groups.

The air cock termed the switch group isolating cock is located on the supply pipe between the pantograph and control reservoir and the switch groups, in the machinery compartment.

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ITEM 6.EMPLOYMENT OF HIGH TENSION (1500 VOLT) CURRENT ON '46'
CLASS LOCOMOTIVES.

When the 1500 volt current is available (via the pantographs) within an electric locomotive ten high tension machines are required to be driven by such in order that the locomotive may function in train haulage.

Six of these machines are called traction motors, four of these machines are called auxiliary machines and are named as follows:

The Supply Motor Generator.
The Exciter Motor Generator.
No. 1 Air Compressor Motor.
No. 2 Air Compressor Motor.

The six traction motors when driven by high tension current will each drive the locomotive axle to which it is connected and thus contribute to the tractive effort of the locomotive.

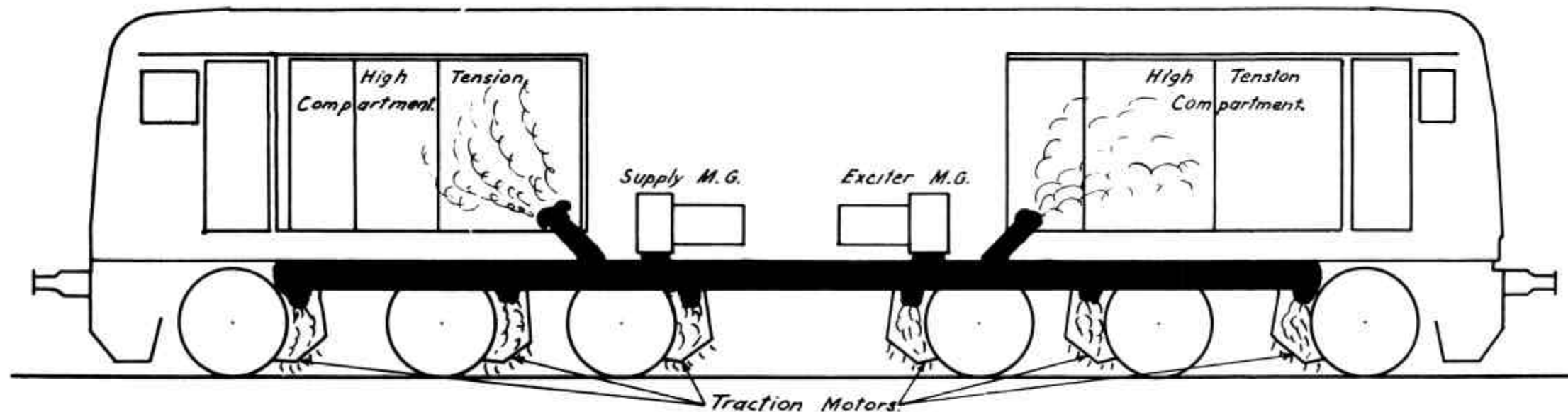
These traction motors are identified by being numbered. Running from the No. 1 end of the locomotive traction motor No. 1 leads, with motors Nos. 2 and 3 following on the No. 1 end bogie truck. No. 4, 5, 6 motors follow in that order on the No. 2 end bogie truck.

The current being fed to Nos. 1, 2, 3 motors is read on the Ammeter, second from the right at the driver's station and the ammeter nearest the fireman-observer's station reads the current being fed to motors 4, 5, 6.

In train haulage the current readings on both ammeters should agree, (except where one bank of motors has been isolated).

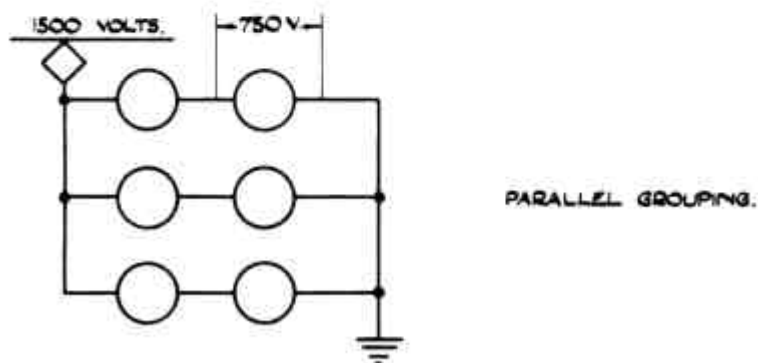
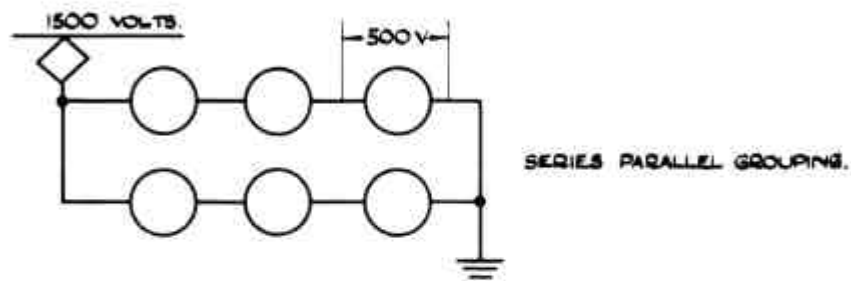
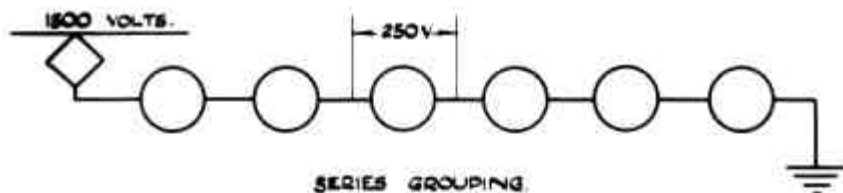
Any disagreement means that the armatures of certain motors are rotating faster than others and therefore wheel slip is occurring.

TRACTION MOTOR AND HIGH TENSION BLOWERS ARRANGEMENT.



To ventilate and to prevent the intrusion of foreign matter to the Traction Motors and to the two High Tension compartments forced draught is applied.

Attached to the Supply Motor Generator and also to the Exciter Motor Generator is a large centrifugal type fan blower. When these machines run a large volume of air is fed into a longitudinal duct. Proportions of this air are fed into each high tension compartment and to each of the Six Traction Motors.



TRACTION MOTOR COMBINATIONS.

The use of the Regenerative Brake on 46 class locomotives employs the six traction motors to retard the locomotive and therefore the train. During this process however, the traction motors are acting as six generators.

The conversion of an electric motor into a generator is a simple matter requiring no alteration to the component parts, but merely some alteration to the current paths or circuits.

During this employment of the motors, the armature ammeter, that meter at extreme right at the driver's station, reads the amount of current now being regenerated by all six motors if the Series Combination is being used. If the Series-Parallel Combination is being used then two banks of motors are regenerating, and the armature ammeter current should be multiplied by two.

The current shown on the Field Ammeter, that meter second from the right reads the strength of the excitation current to the motor fields.

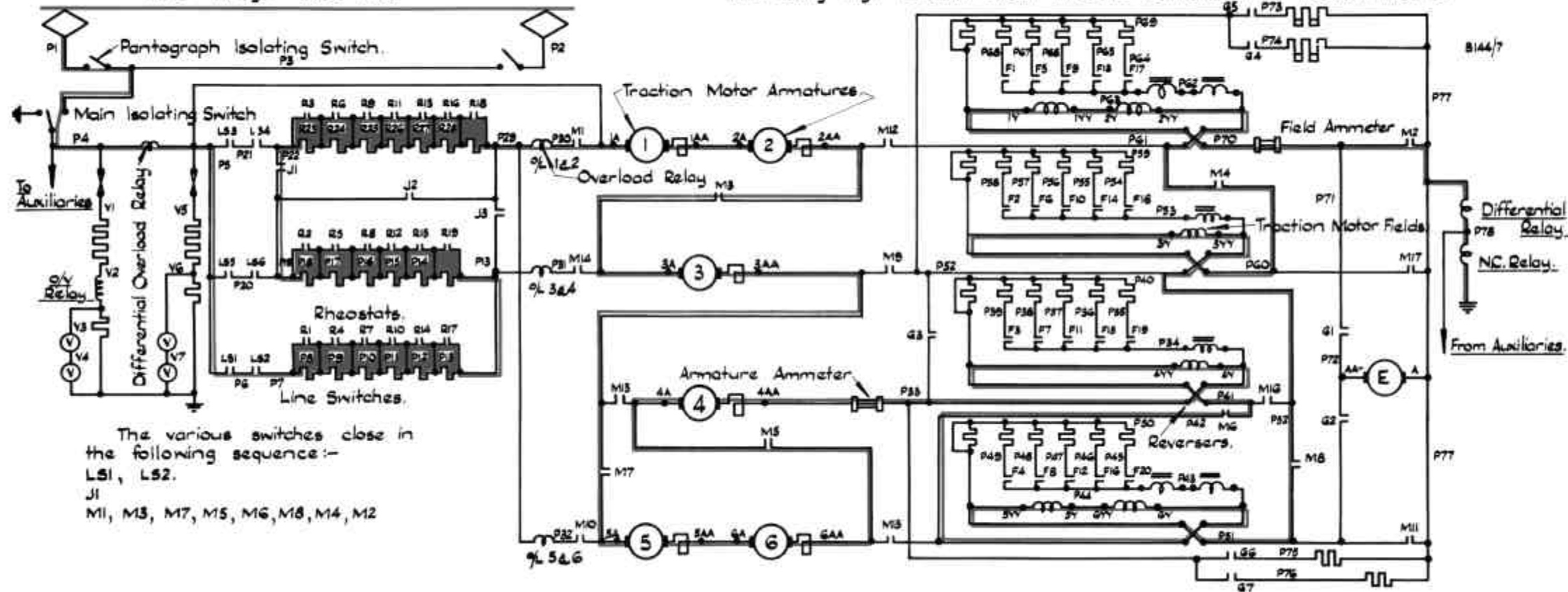
The Supply Motor Generator when driven by high tension current (at 1500 volts) produces low tension current (at 120 volts) for purposes which will be described under instructions dealing with the control circuit.

The Exciter Motor Generator when driven by high tension current (1500 volts) also produces low tension current separate from the former machine output, and this current is used to drive the motors of eight resistances fans, and also to make it possible to convert the six traction motors into generators. Each of the two abovementioned machines also has attached to the armature spindle a large blower fan, so that when the machines run the two blowers run.

These blowers, called traction motor blowers, provide a large volume of air which is routed to the six traction motor, thus assisting in cooling them and also preventing any induction of metal filings, brake shoe dust, etc.

Line Voltage - 1500 volts.

Illustrating High Tension Circuit in Series Combination of Traction Motors.



The various switches close in the following sequence:-

LSI, LS2.

11

M1, M3, M7, M5, M6, M8, M4, M2

When the motors of both No. 1 and No. 2 Air Compressors are driven by high tension current (1500 volts) air is induced, compressed, cooled and stored by the action of the respective compound compressors being so driven.

In summary the high tension circuit forks to two different paths, first the main high tension circuit which is directed through the traction motors, and secondly the auxiliary high tension circuit which junctions and branches away inside the locomotive, to drive the four auxiliary high tension machines. It is quite practicable to drive the four auxiliary machines whilst not using the other fork of the high tension current to the traction motors.

This condition is necessary to take care of the circumstances where the locomotive is standing or coasting.

However, the main high tension circuit cannot be used to drive the six traction motors unless the auxiliary high tension circuit is functioning, because this latter circuit provides a control system for controlling the former.

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ITEM 7.THE CONTROL CIRCUIT.

The control circuit or low tension circuit on 46 class locomotives at 120 volts is supplied and maintained by the Supply Motor Generator.

A nest of storage batteries receives charging from the Supply Motor Generator.

For a very limited period only the charge held in the storage batteries will supply a control circuit and the only correct use of control current from this source of supply is in the initial stage of engine preparation and an emergency on the main line caused by failure of the supply motor generator, which cannot be corrected.

Current from the abovementioned sources is used by the driver to operate the pantographs, also a large group of contactors.

These contactors when operated either connect or disconnect the high tension current to the ten high tension machines of the locomotive and vary the path of such.

The storage batteries on 46 class locomotives have only limited storage capacity, therefore it is important to get the supply motor generator running early in the preparation routine and to keep it running during Traffic service.

When the supply motor generator is running and producing low tension current there is no demand on storage battery current also battery charging is taking place.

A continuous yellow lamp in the cab warns that the supply motor generator is not running.

If the supply motor generator 100 amp. fuse fails, there is no output from that machine even though it is running and battery current automatically takes over and supplies the control circuit. This condition is indicated by a "discharge" indication on the ammeter and the battery contactor will be open also the Exciter Motor Generator will stall.



LOW TENSION PANEL : NO. 2 END.

Additionally the cab heaters and food heaters will fail.

The included simplified Control Schematic diagram should be studied and referred to, as required, to explain the two sources of supply of control current and the reaction to either source failing.

The Battery Contactor is the connecting or dividing point of each source of supply.

This contactor is closed automatically if the supply generator is producing control current and opens automatically if no current is being supplied by the supply generator. A device located in the low tension cabinet controls the Battery contactor.

This device (not shown) is called the Reverse Current Relay, or Generator Automatic switch or Battery Relay.

If this device failed to open the Battery Contactor when no current was being produced by the supply generator, then the Battery current would flow back through the Battery contactor and drive the generator as a motor and discharge the batteries in the process.

.....

ITEM 7.THE CONTROL CIRCUIT.
EXPLANATORY NOTES ON SCHEMATIC.

"A": The Supply Motor Generator which produces current at 120 volts and feeds it through
"B": Which is a 100 amp fuse on to the positive wire.

Control current is now routed through that group of miniature circuit breakers marked "C".

Control current output through "B" will operate a fitting (not shown) called the Battery Relay or Reverse current Relay, or Generator Automatic Switch.

This Battery relay will in turn close the Battery contactor marked "D" and supply current via "E" to the desk control key "F".

Control key "F" will now feed current to that group of miniature circuit breakers marked "G" and outside of the control key to that circuit breaker "H".

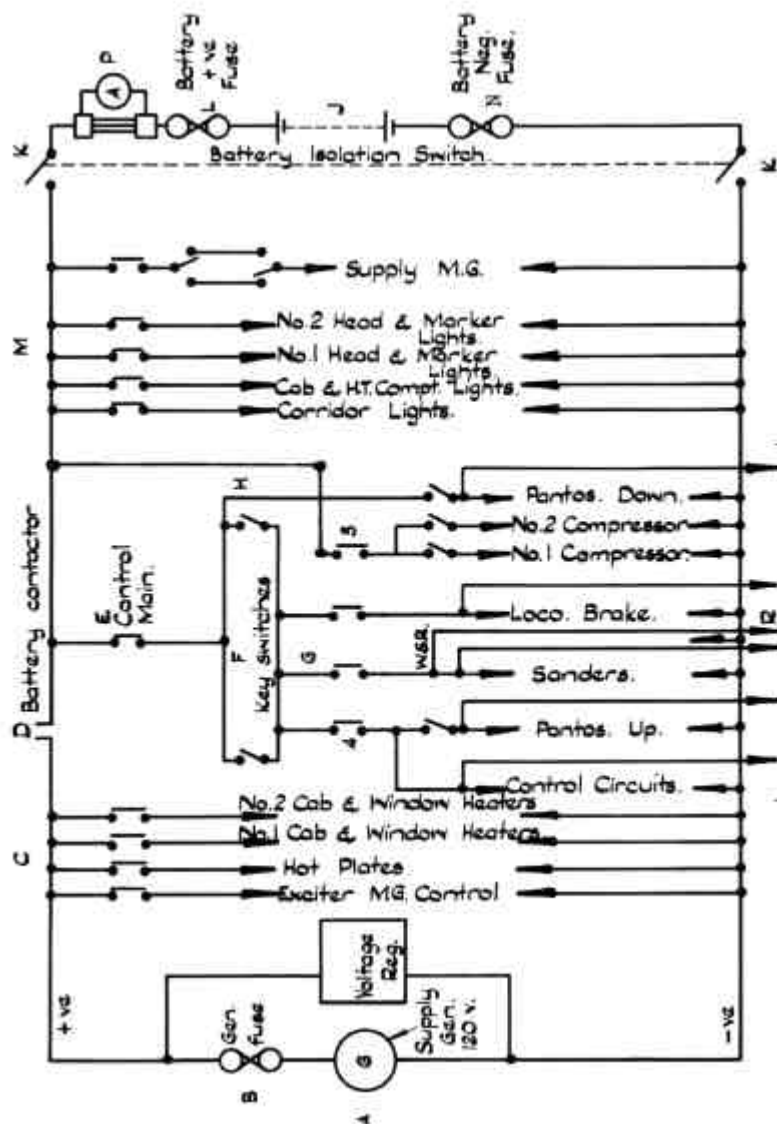
As well as feeding through "E" and connections the current is now available to that group of miniature circuit breakers marked "M".

With the Battery Double pole Switch "K" closed (connected) current feed is available via the 100 ampere fuses marked "L" and "N" to charge a nest of storage batteries marked "J".

The equipment marked "P" is the battery ammeter and this important device readily indicates if the batteries are being charged or discharged.

With no output from the supply motor generator "A" the battery contactor "D" will open and the batteries "J" will provide for a limited time control circuit as far as (but not through) battery contactor "D".

With this limited time battery circuit it will be seen on the simplified schematic all of the miniature circuit breakers marked "M" will be fed.



LOW TENSION CIRCUITS.

Unless the supply generator is producing current that group of miniature circuit breakers marked "C" cannot be fed.

With "E" closed and the supply generator "A" running, and producing current, and the batteries "J" connected through "K", group "E" and "H" are available. The control key must be in and on to feed that group of circuit breakers marked "G".

The extended control lines marked "R" are those which may be extended through the jumper couplers in M.U. working.

If the supply generator "A" or the 100 ampere fuse "B" should fail, the reverse current relay will open and disconnect the battery contactor "D".

The failure of fuses "L" or "N" would cause a failure of the battery circuit.

The failure of fuses "B", "L" or "N" would cause battery charging to cease.

The Battery charging ammeter in the low tension cabinet (No. 2 cab) should never show 'discharge', and the Battery contactor should be closed.

If the ammeter shows 'discharge' and/or the Battery contactor is not closed, inform the driver immediately. These indications show that Battery charging is not occurring and that the locomotive may be operated only for a limited period before total failure of the control circuit.

.....

Indication of depleted batteries on these locomotives is usually by the dimness of the cab lights and can often be detected during the preparation of the locomotive. If the cab lights are not bright before the supply generator starts and the initial charging rate is about 30 amperes this will indicate low batteries.

If the batteries are high the charging should be between 2 and 10 amps.

Where cab lights are observed as being unduly dim when fed from the batteries alone and with the supply motor generator now started up only a low charging rate is indicated on the battery ammeter the condition of the battery is suspect and under these circumstances do not switch off the supply generator before arrival at destination.

The battery ammeter is under all circumstances the best indication of the condition of the batteries and in some cases of very low batteries it is possible for a charge of 50 amps to be indicated, but this charge should not be maintained for more than 10 minutes and in this period should fall to approximately 10 amps. Should the charge rate be maintained at 50 amps for over 10 minutes the battery double pole switch should be opened and the batteries taken out of the charging circuit.

If an inspection of the battery contactor is made at any time do not lift the arc chute covering the contactor whilst the generator is running.

During the course of the preparation make an inspection of the battery ammeter with the generators running and compare the charge rate with the conditions given previously. Before switching off a supply generator make another inspection and do not run the locomotive with the generator switched off. Remember that if the batteries are depleted badly and the generator switched off the locomotive will be a failure.

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ITEM 8.PANTOGRAPHS AND PANTOGRAPH CONTROL.

The Pantograph provides the means of connecting the overhead line voltage or disconnecting it from the locomotive.

Raising or lowering of pantographs must never be done whilst any current is being drawn.

Current is being drawn when either the throttle is open or any of the four auxiliary high tension machines are running.

During light engine running the rear pantograph only is to be employed.

During all train working both pantographs are to be employed.

If only one pantograph is employed in train working all of the machines may be adequately fed, but severe sparking would take place if the current draw was heavy.

However, between Westmead and points East thereof where two or more locomotives are attached, only one pantograph is to be employed on each locomotive.

This exception is due to the lighter nature of the overhead wire.

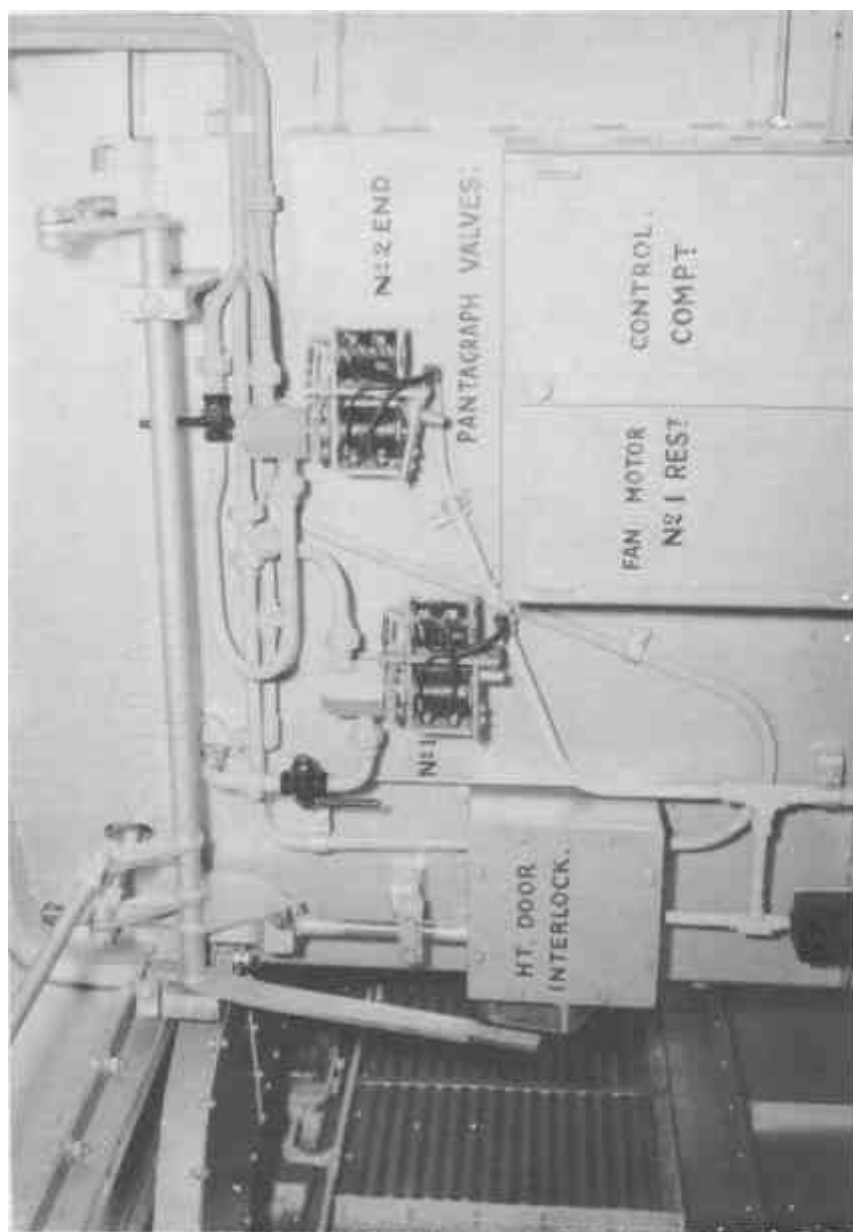
A yellow symbol with a black centre means stop and ascertain that the route intended is wired.

A Red Stop Board means stop and lower and isolate all pantographs if the 46 class locomotive is required to be hauled beyond that point.

Failure to observe these simple rules will cause serious damage to the pantographs.

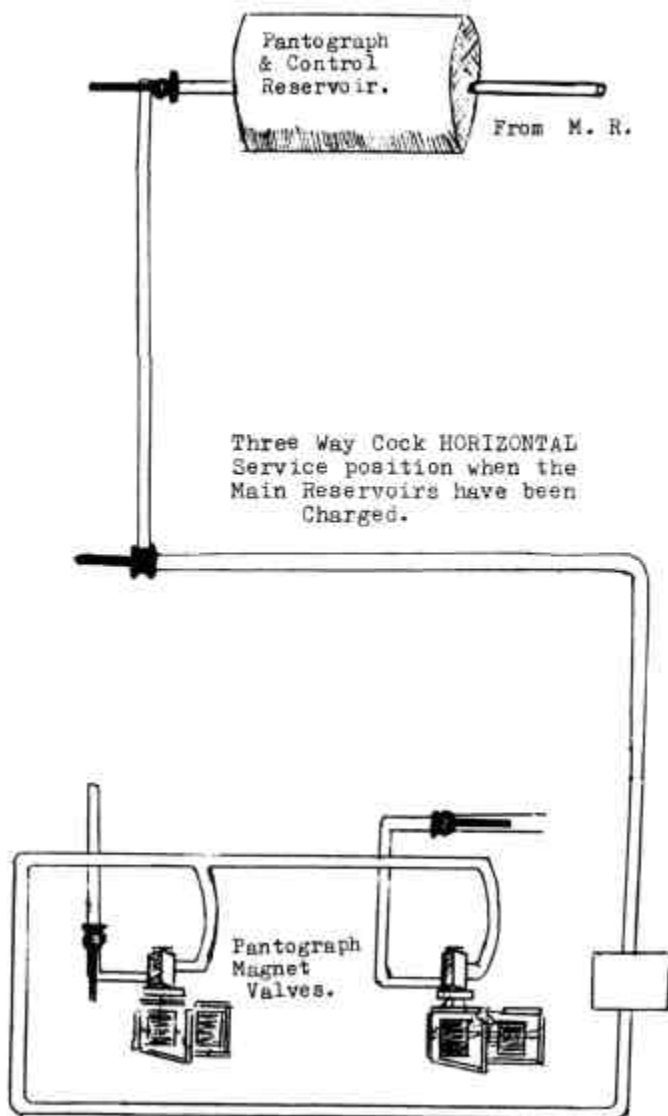
Pantograph Raising and lowering reactions are to be visually inspected by the fireman-observer, with report to the driver.

Before entering a high tension compartment as well as operating the lowering and isolating pantograph mechanism, it is essential to observe that the pantographs have folded down. It is quite possible for the pantograph to remain in contact with the overhead wire after lowering magnet valves have been operated, due to stiffness of the pantograph details.

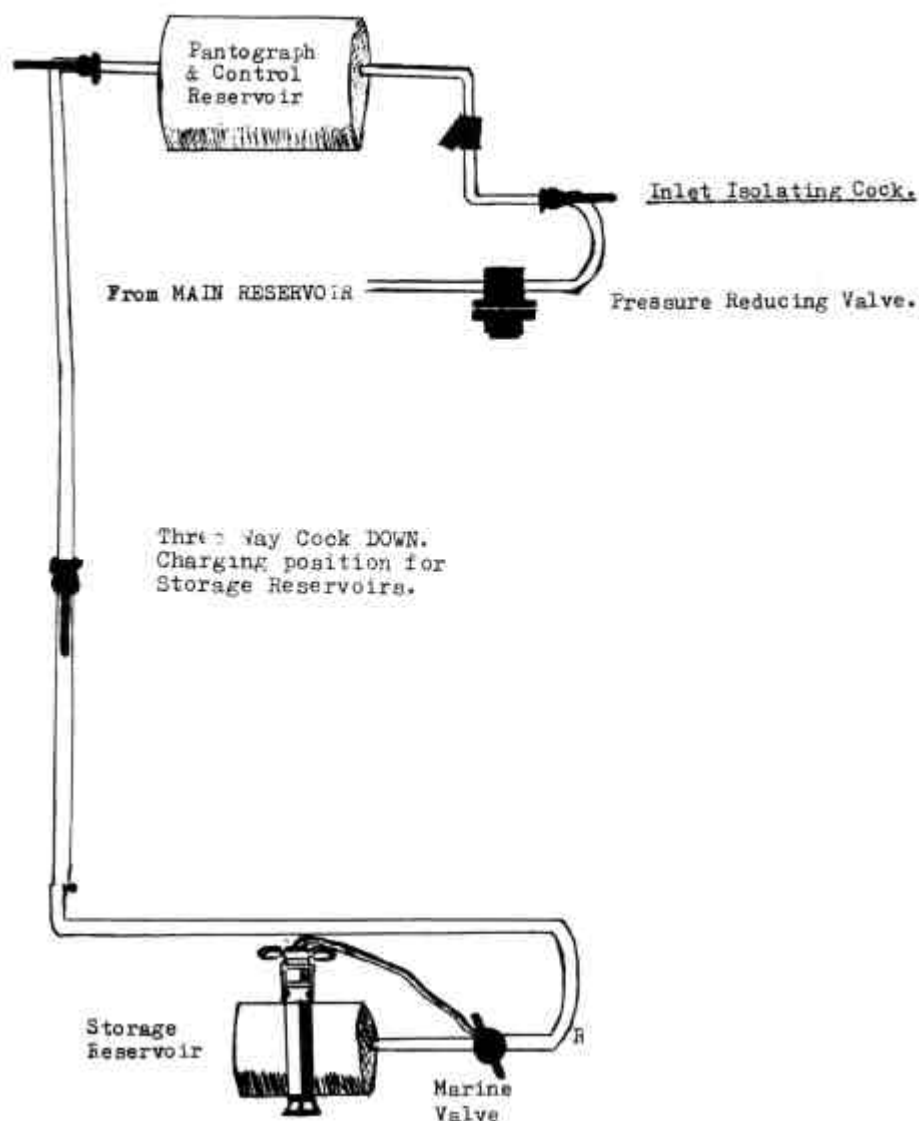


PANTOGRAPH RAISING AND LOWERING MAGNET VALVES.

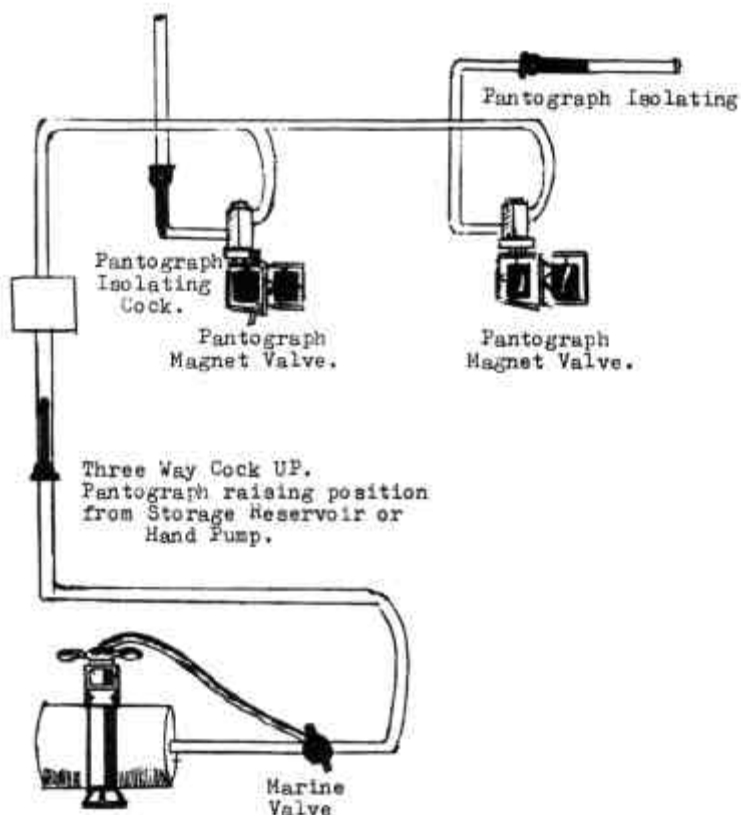
PANTOGRAPH (AIR) CONTROL.
ILLUSTRATING THE THREE WAY COCK.



PANTOGRAPH (AIR) CONTROL.
ILLUSTRATING THE THREE WAY COCK.



PANTOGRAPH (AIR) CONTROL.
ILLUSTRATING THE THREE WAY COCK.



To provide two separate sources of air for pantograph raising air from pantograph and control reservoir is routed to storage reservoir and trapped at marine valve and later also trapped in pantograph and control reservoir by closing inlet and outlet isolating cocks.

To raise a pantograph it is necessary to have a supply of compressed air and to route it to the pantograph cylinder on the roof.

To lower a pantograph it is necessary to prevent air flow to the roof cylinder and to discharge that air already present.

These actions may be made by hand manipulation of the armature plate of the pantograph magnet valve, and this method may be used when a fault exists in the raising or lowering buttons on the cab desk panel.

To raise pantographs by remote (cab desk buttons) control it is necessary that the control current is present through the control key, via the Battery switch.

To lower pantographs by remote (cab desk buttons) control it is not necessary to have the control key switched on, but Battery current must be switched on.

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ITEM 8.PANTOGRAPHS AND PANTOGRAPH CONTROL.

There are two pantograph magnet valves.

Each magnet valve refers to the raising and lowering of one pantograph. (No. 1 end pantograph and No. 2 end pantograph).

Each magnet valve, conforming to that description contained in item 5, has two solenoid coils inbuilt.

When the desk raising button switch is pressed, control current will flow to the raising solenoid. This solenoid now being a temporary magnet will attract the vertical armature plate, which will then allow the horizontal armature plate to fall down.

When this latter armature plate falls down, it permits an air valve to open and route pantograph and control reservoir air pressure to the pantograph roof cylinder.

The piston of the pantograph roof cylinder now forced out to full stroke releases a pawl which permits two raising springs to exert their force on the pantograph, unfolding it and forcing it into contact with the overhead high tension wire with a spring pressure of about 28 P.S.I.

When the desk lowering button switch is pressed, the raising solenoid is de-energised and the lowering solenoid is energised.

The vertical raising armature is released the horizontal lowering armature plate is attracted.

When the lowering armature plate is thus retracted, it engages the air valve, cuts off pantograph and control reservoir air flow and discharges the air from the pantograph roof cylinder.

The pantograph lowering springs now take charge and cause the pantograph to break away from the high tension overhead wire and fold down.

It is necessary to have control current through the desk control key for pantograph raising from the desk buttons.

The pantograph three-way control air cock must be placed horizontal to route air from the pantograph and control reservoir to the pantograph roof cylinder, and it must be placed vertically upwards to route air from the storage reservoir or emergency hand pump.

In both cases, also the pantograph isolating cocks should be open.

These are located immediately above the magnet valves.

If the desk button switches fail to energise either the raising or lowering solenoids of the magnet valves, the armature plates may be hand operated.

Unless the high tension main switch is closed and locked with the Reverser Key, air cannot be routed to the pantograph roof cylinder, and any air contained in the roof cylinder is vented when the main high tension switch is unlocked.

In multiple unit working, the control current which operates the pantographs on the front locomotive, also feeds through the jumper coupler to cause similar actions on the rear locomotive.

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ITEM 9.AIR HOSES ON 46 CLASS LOCOMOTIVES, THEIR EMPLOYMENT AND SPARE HOSE EQUIPMENT TO BE CARRIED. THE LOCATIONS OF AIR HOSES IN USE.

On the Driver's side of the locomotive at each end a 1" head brake pipe end type air hose and dummy coupling.

On the Fireman's side at each end a 3/4" head main reservoir and air hose and dummy coupler - Note - these two (2) air hoses are not interchangeable.

On the Driver's side each end connecting between car body and bogie frame, one sand circuit intermediate type air hose and one brake pipe intermediate air hose.

On the Fireman's side each end connecting between car body and bogie frame, one main reservoir, one brake cylinder, and one sand gear intermediate type air hose.

These intermediate type air hoses are referred to as flexible air hoses as they connect the two mobile portions, the car body and the bogie frames.

Two flexible air hoses on the roof of the 46 class locomotives convey air for the operation of the pantograph pistons.

Two 1/2" type 'B' air hoses which are used in Multiple Unit working to connect across the No. 3 and No. 4 Independent brake pipes are carried when not in use, in the corridor of No. 2 End of the Locomotive.

Spare hoses carried in the equipment box for wayside replacement purposes are:-

- One main reservoir end type air hose.
- One brake pipe end type air hose.
- One flexible intermediate type main reservoir air hose.
- One flexible intermediate type brake cylinder air hose.
- One intermediate type sand circuit air hose.

It should be always remembered that spare main reservoir and brake pipe air hoses are conveniently located on the unconnected end of the locomotive.

No spare replacement flexible hoses for the pantographs are carried.

NOTES OF REPLACEMENT.

The two flexible air hoses on the roof may be separately isolated, should they burst by closing the applicable isolating cock in the machinery compartment. The air pressure in the Pantograph and Control reservoir will readily indicate the isolating of the defective hose.

It should not be overlooked that if the Pantograph and Control Reservoir is greatly in excess of 70 P.S.I., this excess pressure may be the cause of the burst hose. Should excess pressure be the cause of the burst hose, adjust the pressure in the pantograph and control reservoir to 70 P.S.I. at the pressure reducing valve.

During train working if the flow meter indicates a burst air hose:-

- (a) First ascertain if the two intermediate and one end brake pipe hoses on the locomotive are not involved.
- (b) carry the correct spare hose and tool along the train until the burst hose is located.
- (d) where any interference with the brake pipe is necessary take special care that both relevant end air cocks have been fully opened.

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ITEM 10.AUTOMATIC ALARMS AND SAFEGUARDS.

Under this heading there are four devices on the '46' class locomotive.

These are:

- (a) The Line Switch Indicator Lamp.
- (b) The Motor Generators and Resistance Fans Lamp.
- (c) The Wheel Slip Relay Buzzer and Lamp.
- (d) The Westinghouse Brake Flow Meter and Indicator.

(a) The line switch lamp is the red lamp and it will flicker momentarily, as a normal function, when the throttle is moved from "off" to notch one, if the line switches close and connect high tension current feed to the traction motors.

Where due to a fault, one bank of motors has been isolated, the line switch lamps will no longer be in circuit.

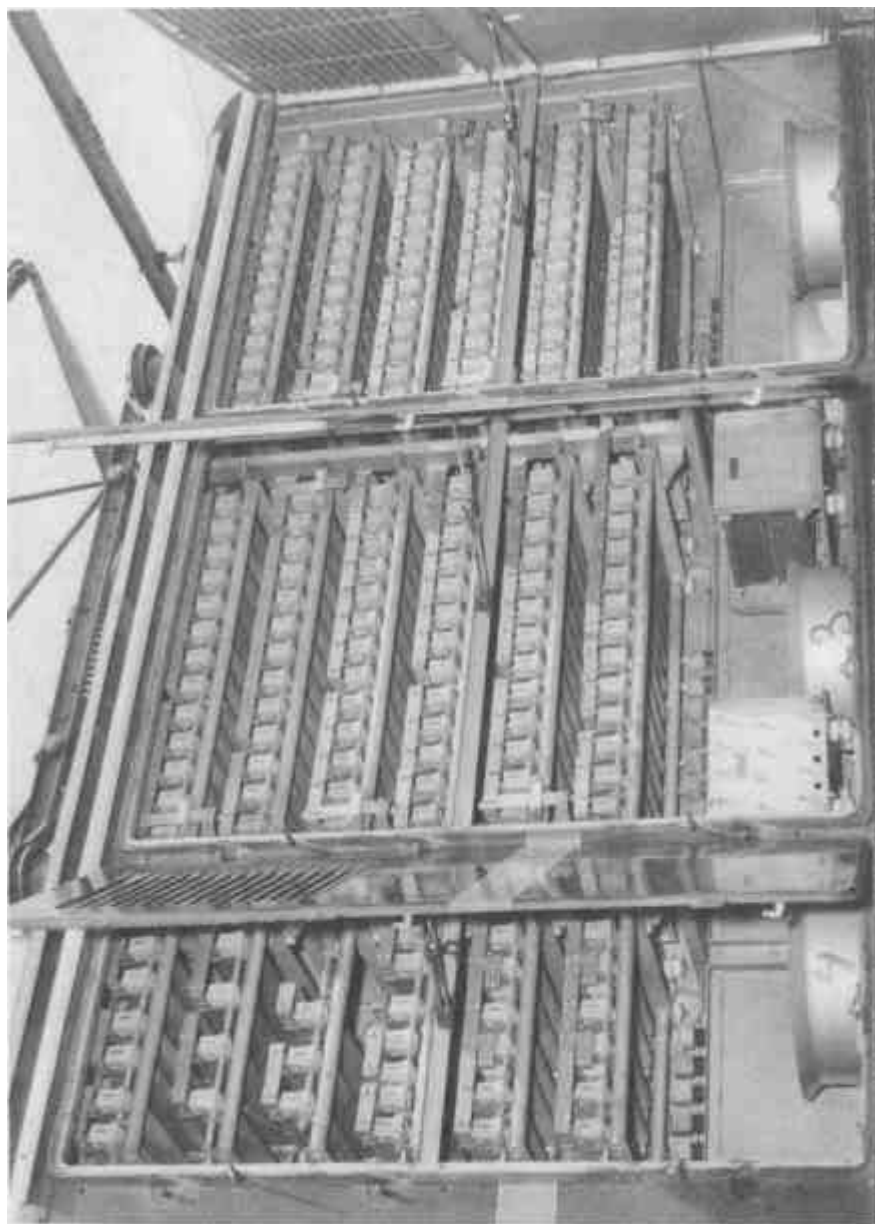
If, whilst the throttle is open, any fault develops in the high tension circuit, one of four protective relays will intervene and automatically open the line switches, on fault, (thus cutting off current flow to the traction motors).

The red lamp will shine continuously to warn the driver of the occurrence.

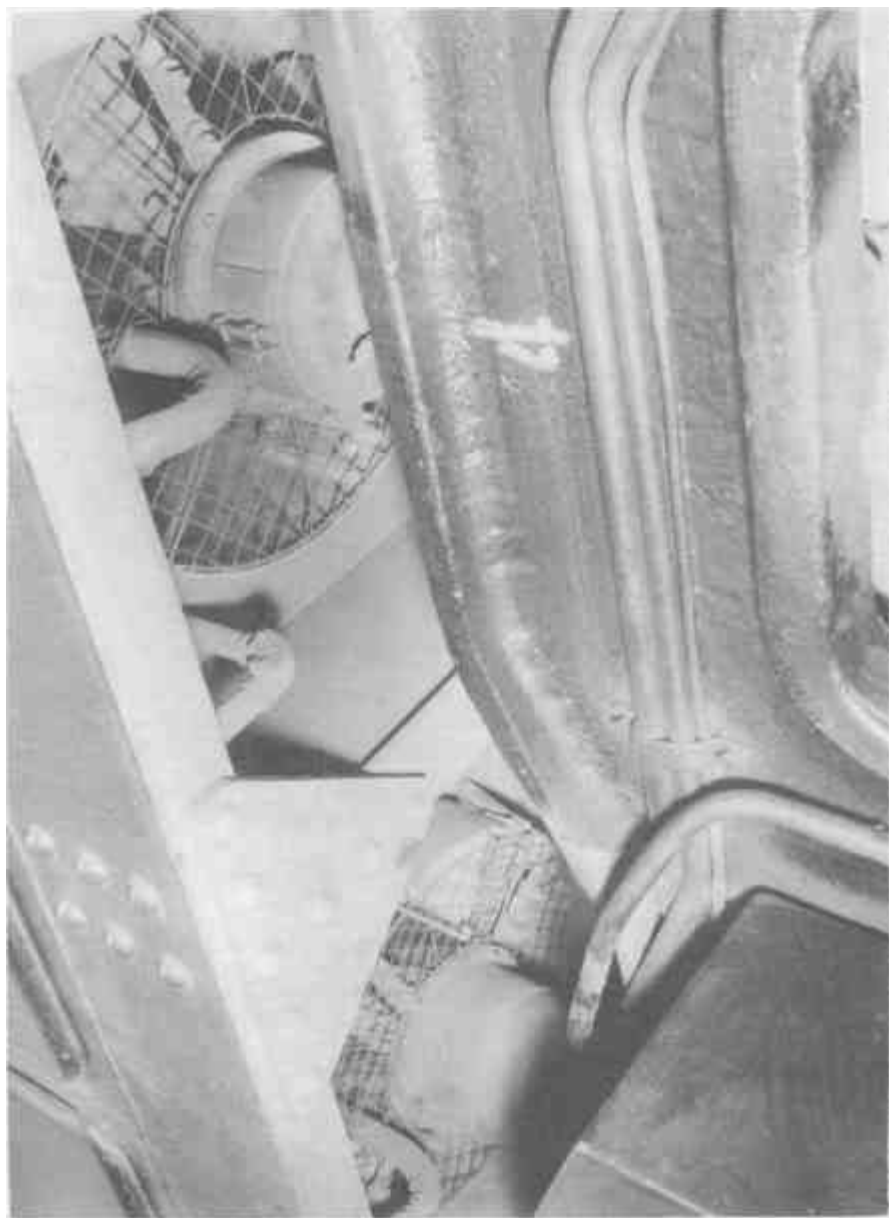
Since the line switches are of the electro-pneumatic type, a failure of the control current circuit, or the control air pressure, would cause these to open on fault.

Again the red lamp would shine in warning.

When the Regenerative Brake lever is moved to the braking field, the red lamp will shine, as an ordinary event, until the throttle is opened.

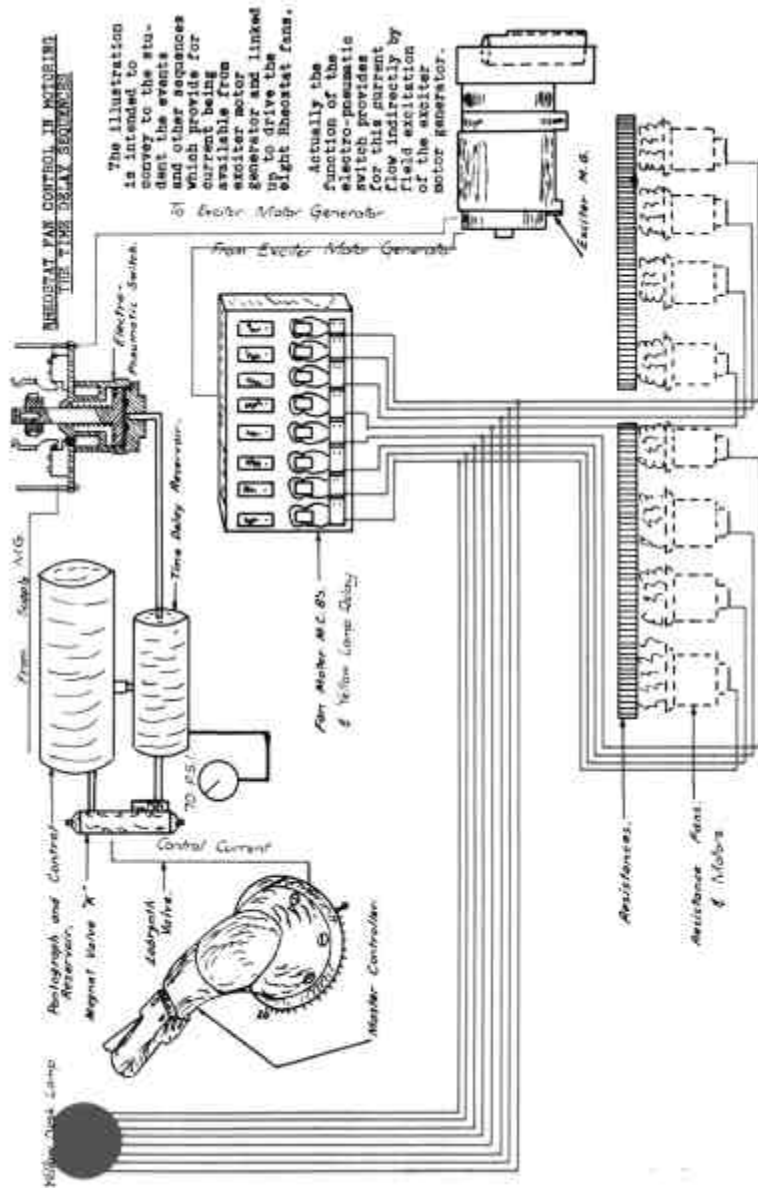


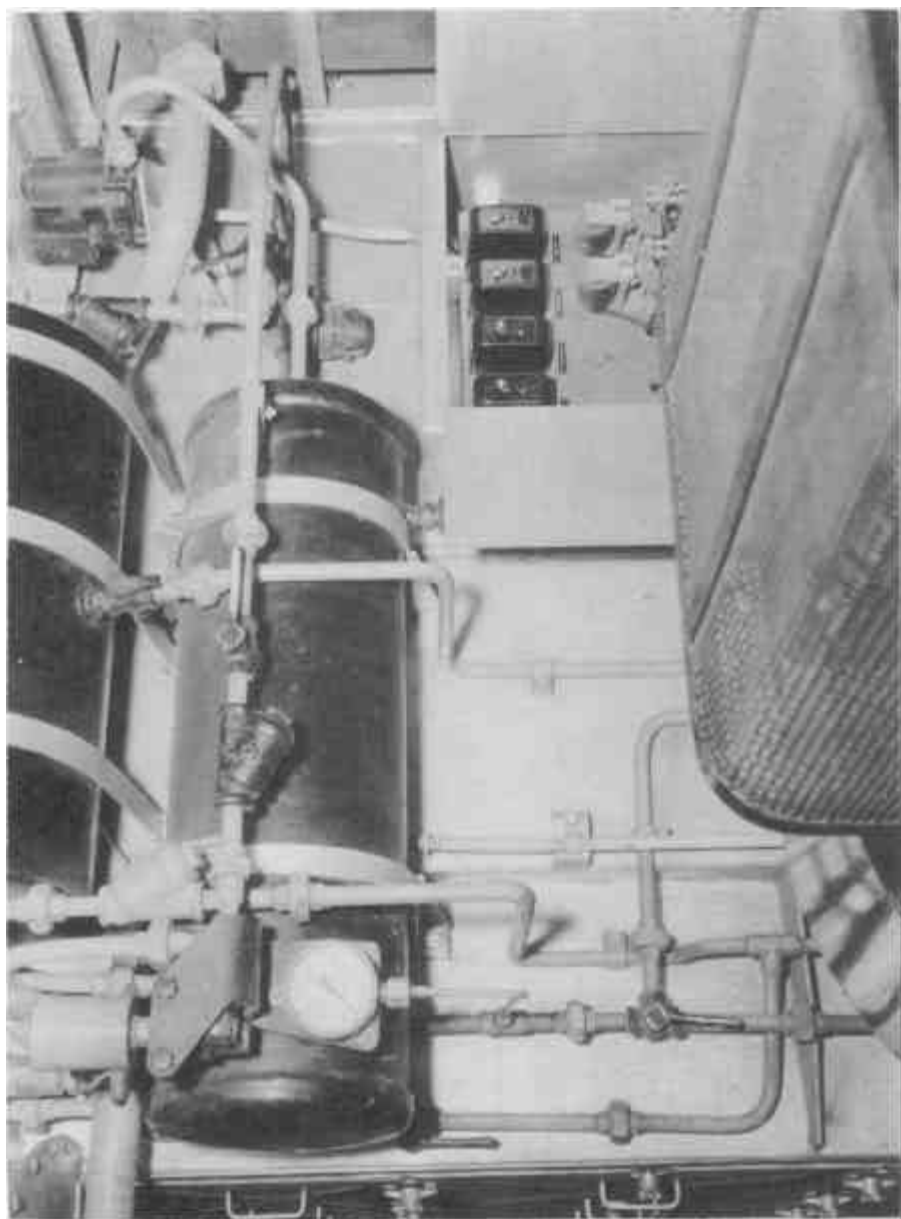
MAIN STARTING RESISTANCES.



RESISTANCE FAN MOTORS.

RESISTANCE FAN MOTOR CIRCUITS.





RESISTANCE FAN MOTOR MINIATURE CIRCUIT BREAKERS
AND FAN TIME DELAY RESERVOIR.

(b) The Motor Generators and Resistance Fans lamp is the yellow lamp.

At all times when control current is available through the Desk Control Key, if the supply motor generator is not running, the yellow lamp will shine continuously to warn the crew that neither the supply motor generator, nor the exciter motor generator is running, and therefore, battery charging is not taking place, that the battery charge is being bled away and that traction motor blowing is not taking place.

When the throttle is opened and until it is positioned at notch twenty (20), the high tension current flowing to the traction motors is being routed through all, or some, of the nineteen main starting resistances in order to graduate the starting effort.

These resistance units are housed in each high tension compartment immediately behind the fireman-observer's station.

These resistance units produce heat which after one minute require forced ventilation.

Below each Resistance Compartment, four powerful resistance (or Rheostat) fans are located.

Each has its own inbuilt motor.

One minute after the high tension current is feeding through the resistances, these eight fan motors should start the fans running to ventilate the resistances.

If all, or any, of these fans fail to run and the throttle has not reached notch 20, the yellow lamp will shine to warn the crew.

The principal causes of resistance fans failure are:

Supply motor generator, (and exciter motor generator) not running.

Resistance fan Thermal Circuit Breakers tripped.

A simple and effective test for the resistance fans is to start up the supply motor generator, turn off and then turn on the desk control key, and then place the throttle in any resistance notch (1-19).

After one minute the yellow lamp will go out if all resistance fans have started up.

Some of the causes of Rheostat fan failures are:

- (1) Supply Motor Generator not running.

Supply Generator is running, but the 100 amp. fuse is burnt out.

The exciter motor generator supplies the current which drives the fan motors, but the exciter motor generator will not run unless the supply motor generator is running and producing current through the 100 amp. fuse.

An electro-pneumatic switch housed in the machinery compartment is used to connect current, or disconnect it from the eight Rheostat fan motors.

A pressure of air at 60 P.S.I. is required to close (connect) this switch.

The 60 P.S.I. air pressure is fed into the Time Delay Reservoir for this purpose from the Pantographs and Control Reservoir. So that if the P. and C. Reservoir is isolated, or does not contain sufficient pressure, or the Time Delay Reservoir is isolated, then the electro-pneumatic switch would not connect up the Rheostat fan current.

Housed in two separate cabinets in the machinery compartment, are a total of eight thermal type circuit breakers.

The current to drive the eight Rheostat fan motors feeds in parallel through these.

If any one, or all, circuit breakers trip under current load that, or those, Rheostat fans will stall and the yellow lamp will shine.

(c) The wheel slip relay equipped to 46 class locomotives is for the purpose of warning the driver of the slip (in motoring) or slide (in Regenerative Braking) of any of the locomotive wheels.

When wheel adhesion to the rail is correct, a similar volume of current is fed to each traction motor (which is pinioned to the related locomotive axle); when any wheel slips the armature of the traction motor has to rotate faster and there is a differential of current feed, therefore, between the gripping and the slipping wheels.

This condition brings the wheel slip relay to life and this relay feeds control current to operate the wheel slip buzzer and pilot lamp. The control current to operate the buzzer and lamp is routed through the Locomotive Sand miniature circuit breaker (No. 5).

Experimentally another relay has been equipped to engine 4625, which comes to life at any time the master controller accelerating handle is positioned at notch one, and again control current will feed the wheel slip buzzer and pilot lamp.

This arrangement is intended as a warning that current is being fed through the resistances and with such insistence that a driver cannot erroneously return the throttle to notch one, when intending to shut off.

(d) The Westinghouse Air Brake Flow Meter and Indicator.

This device has the important function of warning the crew that the brake pipe pressure has been interfered with outside of the operation of the driver.

In other descriptive words, therefore, the flow indicator will warn if the Guard or Passenger Emergency air cocks are opened, if an brake pipe air hose, or any connection is leaking or is burst, and if the train has become divided.

The Flow Indicator will function only if the driver's Automatic Brake Valve handle is in Running Position and the Brake Valve isolating cock open.

The warning of any irregularity in Brake Pipe pressure within the abovementioned conditions, will be made by an insistent blow of warning air at the flow meter vent port and the two pointers of the Flow Indicator will widely separate and remain at that indication until the brake pipe pressure has been restored.

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STATE RAIL AUTHORITY OF NSW



Electric Locomotives

MECHANICAL INSPECTION SCHEDULES

46 Class: 2700 kW (3600 HP)

85 Class: 2700 kW (3600 HP)

86 Class: 2700 kW (3600 HP)

Second Edition (includes 86 Class) - Reprinted August 2003

HB MECINS83.DOC

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

ELECTRIC LOCOMOTIVES.

MECHANICAL INSPECTIONS

'TRIP' INSPECTIONS - 7 Days

'A' INSPECTIONS - 45 Days

'B' INSPECTIONS - 135 Days

'C' INSPECTIONS - 270 Days

OCTOBER, 1982

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

46 AND 85 CLASS ELECTRIC LOCOMOTIVES.

SEQUENCE CHART

AFTER INTRODUCTION TO SERVICE OR AFTER AN EQUIPMENT CHANGE OR GENERAL OVERHAUL THE SEQUENCE BELOW IS TO BE FOLLOWED.

A INSPECTION - 60 days
A INSPECTION - 120 days
B INSPECTION - 180 days
A INSPECTION - 240 days
A INSPECTION - 300 days
C INSPECTION - 360 days

INSPECTION	TRIP	A	B	C
DAYS	7	60	180	360
Drivers Cab & Machine Room	1 to 9	1 to 16	1 to 22	1 to 29
Underneath Locomotive	30 to 39	30 to 45	30 to 50	30 to 54
Lubrication	55 to 61	55 to 70	55 to 74	55 to 89
Air Brake	90 to 94	90 to 99	90 to 106	90 to 115

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

ELECTRIC LOCOMOTIVES.

MECHANICAL INSPECTION SCHEDULE - TRIP INSPECTION.

LOCO. NO. _____ DEPOT _____
DATE _____ KILOMETRAGE _____

NO.	ITEM	FITTER'S NAME PRINTED
<u>Driver's Cabins and Machine Room Section.</u>		
1.	Sands whistles.	_____
2.	Log book report, gauges, wipers and washers.	_____
3.	Hasler speedometer.	_____
4.	Physical inspection.	_____
5.	Panto pans and condition of pantograph.	_____
6.	Spare equipment box and seals.	_____
7.	Spare "Trip" Inspection.	_____
8.	Spare "Trip" Inspection.	_____
9.	Spare "Trip" Inspection.	_____
<u>Underneath Locomotive Section.</u>		
30.	Traction motor cooling air flow.	_____
31.	Traction motor nose suspension.	_____
32.	Hasler transmitter and speed generators.	_____
33.	Bolster mounting pads.	_____
34.	Wheel examination.	_____
35.	Shock absorber.	_____
36.	Examine bogies.	_____
37.	Spare "Trip" Inspection.	_____
38.	Spare "Trip" Inspection.	_____
39.	Spare "Trip" Inspection.	_____
<u>Lubrication Section.</u>		
55.	Air compressor oil level.	_____
56.	Traction motor gearcases.	_____
57.	Grease bogie.	_____
58.	Suspension bearing oil level.	_____
59.	Spare "Trip" Inspection.	_____
60.	Spare "Trip" Inspection.	_____
61.	Spare "Trip" Inspection.	_____

Air Brake Section.

90. Vigilance Control Equipment.

91. Air brake equipment.

92. Spare "Trip" Inspection.

93. Spare "Trip" Inspection.

94. Spare "Trip" Inspection.

REMARKS AND/OR REPAIRS

REPAIRS EFFECTED

Signature of Foreman on completion of Trip Inspection

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

ELECTRIC LOCOMOTIVES.

MECHANICAL INSPECTION SCHEDULE.

This sheet issued for A, B and C Inspections.

INSPECTION SCHEDULE	ITEM NO.	FITTER'S NAME PRINTED
<u>"A" Inspection.</u>		
Drivers Cabins and Machine Room.	1 to 16	_____
Underneath Locomotive.	30 to 45	_____
Lubrication.	55 to 70	_____
Air Brakes.	90 to 99	_____

Signature of Foreman on completion of "A" Inspection_____

<u>"B" Inspection.</u>		
Drivers Cabins and Machine Room.	1 to 22	_____
Underneath Locomotive.	30 to 50	_____
Lubrication.	55 to 74	_____
Air Brakes.	90 to 106	_____

Signature of Foreman on completion of "B" Inspection_____

<u>"C" Inspection.</u>		
Drivers Cabins and Machine Room.	1 to 29	_____
Underneath Locomotive.	30 to 54	_____
Lubrication.	55 to 89	_____
Air Brakes.	90 to 115	_____

Signature of Foreman on completion of "C" Inspection_____

<u>REMARKS AND/OR REPAIRS</u>	<u>REPAIRS EFFECTED</u>
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____
_____	_____

Signature of Foreman on completion of repairs. _____

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

46 AND 85 CLASS LOCOMOTIVES.

NUMERICAL INDEX.

DRIVERS CABINS AND ENGINE ROOM SECTION.

- T1. Sands and Whistles.
- T2. Log Book Report, Gauges, Wipers and Washers.
- T3. Hasler Speedometer.
- T4. Physical Inspection.
- T5. Pantograph, Condition of.
- T6. Inspect Spare Equipment Box and Seals.
Check Detonator Container and Seals.
- T7. Spare 'T' Inspection.
- T8. Spare 'T' Inspection.
- T9. Spare 'T' Inspection.
- A10. Doors and Windows, etc.
- A11. Ablution Tank.
- A12. Pantograph Insulators.
- A13. Vortacool Refrigerator.
- A14. Spare 'A' Inspection.
- A15. Spare 'A' Inspection.
- A16. Spare 'A' Inspection.
- B17. Pantograph Spring Pressure and Operation.
- B18. Pantograph Hand/Foot pump.
- B19. Raise and Lower Valve.
- B20. Spare 'B' Inspection.
- B21. Spare 'B' Inspection.
- B22. Spare 'B' Inspection.
- C23. Holding Down Bolts.
- C24. Traction Motor Blower Impellers.
- C25. Vortacool Refrigerator.
- C26. Panto 3 Way Cock.
- C27. Spare 'C' Inspection.
- C28. Spare 'C' Inspection.
- C29. Spare 'C' Inspection.

UNDERNEATH LOCOMOTIVE SECTION.

- T30. Traction Motor Cooling Air Flow.
- T31. Traction Motor Nose Suspension.
- T32. Hasler Transmitter and Speed Generator.
- T33. Bolster Mounting Pads.
- T34. Wheel Examination.
- T35. Shock Absorbers.
- T36. Examine Bogies for Loose or Broken Parts.
- T37. Spare 'T' Inspection.
- T38. Spare 'T' Inspection.
- T39. Spare 'T' Inspection.
- A40. Automatic Couplers.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

46 AND 85 CLASS LOCOMOTIVES.

NUMERICAL INDEX CONT'D.

Underneath Locomotive Section.

- A41. Shock Absorbers.
- A42. Compressor Seals and Flexible Drives.
- A43. Spare 'A' Inspection.
- A44. Spare 'A' Inspection.
- A45. Spare 'A' Inspection.
- B46. Bogies.
- B47. Air compressor mountings.
- B48. Spare 'B' Inspection.
- B49. Spare 'B' Inspection.
- B50. Spare 'B' Inspection.
- C51. Suspension Bearing Bolts.
- C52. Spare 'C' Inspection.
- C53. Spare 'C' Inspection.
- C54. Spare 'C' Inspection.

LUBRICATION SECTION.

- T55. Air Compressor Oil Level.
- T56. Traction Motor Gear Cases.
- T57. Grease Bogie as Required.
- T58. Suspension Bearings Oil Level.
- T59. Spare 'T' Inspection.
- T60. Spare 'T' Inspection.
- T61. Spare 'T' Inspection.
- A62. Door and Window Hardware.
- A63. Air Cocks at Headstock.
- A64. Brake Rigging.
- A65. Brake Slack Adjusters.
- A66. Grease Pantographs.
- A67. Lubricate D.B.V. and I.B.V.
- A68. Spare 'A' Inspection.
- A69. Spare 'A' Inspection.
- A70. Spare 'A' Inspection.
- B71. Handbrake.
- B72. Suspension Bearing Lubricator Pads.
- B73. Spare 'B' Inspection.
- B74. Spare 'B' Inspection.
- C75. Windscreen Wipers.
- C76. Drivers and Observers Seats.
- C77. Peacock Handbrake.
- C78. Brake Cylinders.
- C79. Hasler Speedometer Transmitter.
- C80. Air Compressor Oil Filter.
- C81. Air Compressor Oil Change.
- C82. Air Compressor Motor.
- C83. Brake Slack Adjuster Bush.
- C84. Axle Box Roller Bearings (every 2nd C inspection)
- C85. Traction Motor Bearings (every 2nd C inspection)
- C86. Motor Alternator Bearings (every 2nd C inspection)
- C87. Spare 'C' Inspection.
- C88. Spare 'C' Inspection.
- C89. Spare 'C' Inspection.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

46 AND 85 CLASS LOCOMOTIVES.

NUMERICAL INDEX CONT'D.

AIR BRAKE SECTION.

- T90. Vigilance Control Equipment.
- T91. Air Brake Equipment.
- T92. Spare 'T' Inspection.
- T93. Spare 'T' Inspection.
- T94. Spare 'T' Inspection.
- A95. Safety Valves.
- A96. Air Compressor Air Intake Filters.
- A97. Spare 'A' Inspection.
- A98. Spare 'A' Inspection.
- A99. Spare 'A' Inspection.
- B100. Main Reservoir Auto Drain Valve Check.
- B101. Check P and C Pressure.
- B102. Compressor Governor.
- B103. Control Governor.
- B104. Spare 'B' Inspection.
- B105. Spare 'B' Inspection.
- B106. Spare 'B' Inspection.
- C107. Air Compressor Valves.
- C108. Air Compressor Breather.
- C109. Air Compressor Air Intake Filters.
- C110. Air Compressor Intercooler Auto Drain Valve.
- C111. Gauges.
- C112. Air Strainers.
- C113. Spare 'C' Inspection.
- C114. Spare 'C' Inspection.
- C115. Spare 'C' Inspection.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

46 AND 85 CLASS LOCOMOTIVES.

ALPHABETICAL INDEX.

<u>ITEM</u>	<u>ITEM NO.</u>
Ablution Tank	A11
Automatic Couplers	A40
Air Compressor Mountings	B47
Air Compressor Oil Level	T55
Air Cocks at Headstock	A63
Air Compressor Oil Filter	C80
Air Compressor Oil Change	C81
Air Compressor Motor	C82
Axle Box Roller Bearings	C84
Air Brake Equipment	T91
Air Compressor Air Intake Filters	A96
Air Compressor Air Intake Filters	C109
Air Compressor Valves	C107
Air Compressor Breather	C108
Air Compressor Air Filter	C109
Air Compressor Intercooler Auto Drain Valve	C110
Air Compressor Seals and Flexible Drives	A42
Air Strainers	C112
Bolster Mounting Pads	T33
Bogies	B46
Brake Rigging	A64
Brake Slack Adjusters	A65
Brake Cylinders	C78
Brake Slack Adjuster Bush	C83
Check P and C Pressure	B101
Compressor Governor	B102
Control Governor	B103
Doors, Windows, etc.	A10
Door and Window Hardware	A62
Drivers and observers Seat	C76
Examine Bogie for Loose or Broken Parts	T36
Gauges	C111
Grease Bogie as required	T57
Grease Pantographs	A66
Hasler Speedometer	T3
Holding Down Bolts	C23
Hasler Transmitter and Speed Generator	T32
Handbrake	B71
Handbrake; Peacock	C77
Hasler Speedometer Transmitter	C79
Log Book Report, Gauges, wipers and washers	T2
Lubricate D.B.V. and I.B.V.	A67
Main Reservoir Auto Drain Valves	B100
Motor Alternator Bearings	C85
Physical Inspection	T4
Pantograph, Condition of	T5

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

46 AND 85 CLASS LOCOMOTIVES.

Alphabetical Index cont'd.

<u>ITEM</u>	<u>ITEM NO.</u>
Pantograph Insulators	A12
Pantograph Spring Pressure & Operation	B17
Panto 3 Way Cock	C26
Pantograph Hand/Foot Pump	B18
Raise and Lower Valve	B19
Sands and Whistles	T1
Safety Valves	A95
Shock Absorber	T35
Shock Absorbers	A41
Spare Equipment Box and Seals	T6
Suspension Bearing Bolts	C51
Suspension Bearing Lubricator Pads	B72
Suspension Bearings Oil Level	T58
Traction Motor Blower Impellers	C24
Traction Motor Cooling Air Flow	T30
Traction Motor Nose Suspension	T31
Traction Motor Bearings	C85
Traction Motor Gear Cases	T56
Vigilance Control Equipment	T90
Vortacool Refrigerator	A13
Vortacool Refrigeration	C25
Wheel Examination	T34
Windscreen Wipers	C75

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

46 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

DRIVERS CABINS AND ENGINE ROOM SECTION.

T1. SANDS WHISTLES.

Check the operation of the following outside the shop:-

- (a) Sanders: Sand discharge per pipe 0.5 kg to 0.7 kg (1-1 1/2 lbs) per minute. Check pipe alignment - 40 m.m. (1 1/2") above rail level.
- (b) Whistles: Test both sides of cabs.

T2. LOG BOOK REPORT, GAUGES, WIPERS AND WASHERS.

In Driver's Cab, check:-

- (a) Log Book entries.
Attend to bookings as recorded by the Driver.
- (b) All gauge readings.
- (c) All windscreen wipers operation.
- (d) All windscreen washers operation, top up water container.

T3. HASLER SPEEDOMETER.

Wind clock and set hands if necessary.

Blue dot indicates p.m.

Check locomotive log book for kilometrage run since the last diagram roll change (anticipated life 3500 km). Change if required.

When installing or removing the roll, mark on the roll and in the top right hand corner of the Log Book the Locomotive number, Time, Date and relevant details.

NOTE: Reduce brake pipe pressure to zero with the automatic brake valve before closing the instrument case after installing a new roll to ensure the stylus for the brake line is correctly positioned.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

46 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

DRIVERS CABINS AND ENGINE ROOM SECTION.

T4. PHYSICAL INSPECTION.

Examine locomotive internally and externally for defects and fractures. Report any findings to Foreman.

T5. PANTO PANS AND CONDITION OF PANTOGRAPH.

Check the following:-

- (a) Shunts on pan knuckle and frame for tightness, overheating or damage.
- (b) Alignment of pans for twist.
- (c) Springs for breakage or weakness.
- (d) Pan supports for fracture.
- (e) Pistons for blow-by.
- (f) Saddles for loose pins and fractures.
- (g) Air hoses for leaking or signs of failure.
- (h) Check all insulators for damage.

Changing of Pans.

Change carbon strips when wear has occurred to 5/16" thickness from pan surface or if the strips are deeply grooved, severely chipped or securing bolts are loose.

T6. INSPECT SPARE EQUIPMENT BOX & SEALS, CHECK DETONATOR CONTAINERS & SEALS.

Replace if necessary using standard seal and sealing pliers.

T7. Spare 'T' Inspection.

T8. Spare 'T' Inspection.

T9. Spare 'T' Inspection.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

46 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

DRIVERS CABINS AND ENGINE ROOM SECTION.

A10. DOORS AND WINDOWS, ETC.

Check all cab, machine room and bulkhead doors; locks, hinges, seals, window frames.

Repair where required.

A11. ABLUTION TANK.

NOT APPLICABLE.

A12. PANTOGRAPH INSULATION.

Clean pantograph insulators using a cloth dampened in solvent. Do not use abrasive material.

A13. VORTACOOOL REFRIGERATOR.

NOT APPLICABLE.

A14. Spare 'A' Inspection.

A15. Spare 'A' Inspection.

A16. Spare 'A' Inspection.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

46 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

DRIVERS CABINS AND ENGINE ROOM SECTION.

B17. PANTOGRAPH SPRING PRESSURE AND OPERATION.

Pantograph spring pressure is measured with a spring balance and should be 9.8 kg (22 lbs). Adjustment is made by increasing or decreasing, the length of the two main springs (equally on both sides).

The time of raising the pantograph should not exceed 20 seconds with a 3 foot maximum lift. If the time is exceeded, adjust the speed control which is located adjacent to the pantograph air cylinder.

When lowering the pantograph the quick release valve should function so that the pantograph leaves the wire quickly to reduce the effect of arcing. At a height of about 6" from the down position a cushioning effect should check the speed of the pantograph. If the cushioning occurs too soon or too late then adjustment is carried out by means of the fitting at the centre of the pressure head of the air cylinder.

B18. PANTOGRAPH HAND/FOOT PUMP.

Drain all air from main reservoirs, check operation of hand pump by using pump to raise pantograph. Replace pump if defective.

B19. RAISE AND LOWER VALVE.

Check that latch tongue and ledge are clean and sharp with no undue wear.

Adjustment.

- (1) Push rod should protrude 0.8 m.m. (1/32") below armature plate when latched up. Renew push rod when less than 0.4 m.m. (1/64").
- (2) Manually push horizontal armature fully up and check clearance. of 0.4 m.m. (1/64") between the armature edge and the brass latching ledge on vertical armature.
- (3) Manually push the vertical armature to the right and check the clearance of 0.4 m.m. (1/64") between the falling armature and the brass plate. Correct 2 and 3 by packing under the appropriate hinge plate.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

46 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

DRIVERS CABINS AND ENGINE ROOM SECTION.

B20. Spare 'B' Inspection.

B21. Spare 'B' Inspection.

B22. Spare 'B' Inspection.

C23. HOLDING DOWN BOLTS.

Check the tightness of the following:-

Traction motor blower housing.

C24. TRACTION MOTOR BLOWER IMPELLERS.

Inspect impeller for defects.

Remove any deposits on the impellers, if necessary. Clean in situ. Cover lower blades with cleaning cloths and exercise care in not allowing foreign matter into the air passages.

C25. VORTACOOOL REFRIGERATION.

NOT APPLICABLE.

C26. PANTO 3 WAY COCK.

Lower pantographs, remove cap from back of cock, check spring and test that air release hole in cap is free. Remove handle and barrel, clean inside of barrel with cloth dipped in kerosine, dry with clean dry cloth. Lubricate with Lithium Base Grease No.3, Stores Item 5285EA. Re-assemble and check that cock operates freely.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

46 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

DRIVERS CABINS AND ENGINE ROOM SECTION.

C27. Spare 'C' Inspection.

C28. Spare 'C' Inspection.

C29. Spare 'C' Inspection.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

46 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

UNDERNEATH LOCOMOTIVE SECTION.

T30. TRACTION MOTOR COOLING AIRFLOW.

Check the cooling air flow from the traction motors.

Check the cooling air flow through the air compressor cylinder heads.

Examine the air bellows, wear plates and arms for alignment, leakage and damage. Ensure setscrews are tight.

T31. TRACTION MOTOR NOSE SUSPENSION.

Check the traction motor nose suspension assemblies and wear plates.

Refer to Item 11 in Appendix A, Page AX20.

T32. HASLER TRANSMITTER AND SPEED GENERATORS.

Check the security of the Hasler transmitter.

T33. BOLSTER MOUNTING PADS.

NOT APPLICABLE

T34. WHEEL EXAMINATION.

All wheel flanges to be examined for arrised condition and corrected if required.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

46 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

UNDERNEATH LOCOMOTIVE SECTION.

T35. SHOCK ABSORBER.

NOT APPLICABLE.

T36. EXAMINE BOGIES FOR LOOSE OR BROKEN PARTS.

Check coil and leaf springs, compensating link pins and associated equipment for breakage, misalignment, etc.

T37. Spare 'T' Inspection.

T38. Spare 'T' Inspection.

T39. Spare 'T' Inspection.

T40. AUTOMATIC COUPLERS.

Check auto coupler height 865 m.m. +/- 25 m.m. (34" +/-1") measured from rail level to the centre line of the coupler knuckle.

Refer to Item 13 in Appendix A, Page AX23.

Gauge auto couplers at both ends.

T41. SHOCK ABSORBERS.

NOT APPLICABLE.

T42. COMPRESSOR SEALS AND FLEXIBLE DRIVES.

Check compressor seals for leaking, replace compressor if leak is excessive. Examine flexible drives for wear or deterioration of rubber inserts, replace if necessary.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

46 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

UNDERNEATH LOCOMOTIVE SECTION.

A43. Spare 'A' Inspection.

A44. Spare 'A' Inspection.

A45. Spare 'A' Inspection.

B46. BOGIES.

Check:-

- (a) Side bearer clearance - 1/32"
- (b) Bogie side check clearance
- (c) End bearers for condition, inspect under metal dust covers and check oil level.
- (d) Motor nose brackets and lateral link bolts and pins.
- (e) Suspension bearing bolts.
- (f) Bottom yoke plate.
- (g) Draw gear rubber (Waughgould gear) check for loose plates and deteriorating rubber.
- (h) Spring stirrup alignment (must be kept from wearing inside of bogie frame). Misalignment may be caused by excessive wear in axle box guides.
- (i) Coil springs are not broken or compressed.
- (j) Articulating gear pins and beam for wear.

B47. AIR COMPRESSOR MOUNTINGS.

Check security of compressor mountings.

B48. Spare 'B' Inspection.

B49. Spare 'B' Inspection.

B50. Spare 'B' Inspection.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

46 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

UNDERNEATH LOCOMOTIVE SECTION.

C51. SUSPENSION BEARING BOLTS.

Tighten bolts with tension wrench set at 1084 Joules (800 ft/lb).

C52. Spare 'C' Inspection.

C53. Spare 'C' Inspection.

C54. Spare 'C' Inspection.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

46 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

LUBRICATION SECTION.

T55. AIR COMPRESSOR OIL LEVEL.

With the compressor stopped, check the air compressor's lube oil level. Replenish with SAE.30 lube oil, Item 5255C.

Check gaskets and inspection covers for oil leaks.

T56. TRACTION MOTOR GEARCASES.

Add lubricant as necessary to maintain a heavy film on gear teeth.

For gearcases with inspection plugs or covers, maintain lubricant level at the bottom of the inspection plug hole.

Use Caltex Gear Lube T.M. 7500, M.I. 26819904, in 450g (1 lb.) white polyethylene bags.

T57. GREASE BOGIE AS REQUIRED.

- (a) Axle box guides.
- (b) Draw bar pins.
- (c) Spring hanger pins, and guides.
- (d) Brake hanger pins.
- (e) Compensating beam pins.
- (f) Brake shaft bearings, with Lithium Base Grease No.3, Stores Item 5285EA.

T58. SUSPENSION BEARING OIL LEVEL.

Inspect and top up if required. Level in bearings, Max - to bottom of filling pipe, Min - 1 1/2" below maximum. Quantity between maximum and minimum - 3 1/2 pints. Gauges are provided for checking oil level. Bearings - Red Axle Oil, Stores Item 6482B.

T59. Spare 'T' Inspection.

T60. Spare 'T' Inspection.

T61. Spare 'T' Inspection.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

46 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

LUBRICATION SECTION.

A62. DOOR AND WINDOW HARDWARE.

Lightly lubricate hinges, lock, slides, etc.

Use Rocol M.I. 15514201.

A63. AIR COCKS AT HEADSTOCK.

Check all cocks for freedom of movement and that there is some resistance to movement. Grease where necessary with multi-purpose grease, Item 5285E.

NOTE: Springs on 18 m.m. (3/4") and 25 m.m. (1") cocks are to have 4.5 m.m. (3/16") compression. Springs on 12.5 m.m. (1/2") cocks are to have 3 m.m. (1/8") compression. Ball type cocks are not to be fitted.

A64. BRAKE RIGGING.

Lightly lubricate pins and bushings with hand oiler. Use SAE.30 lube oil, Item 5255C.

A65. BRAKE SLACK ADJUSTERS.

NOT APPLICABLE.

A66. GREASE PANTOGRAPHS.

All nipples on the following items must be greased. Pan support mechanism top and bottom frame hinges, equalising links, main ball bearings, main outer spring support points, push down spring spherical bearings at fixed ends, lever end of push rod, push rod roller, cylinder piston rod guide, piston lubricator on cylinder. (Total nipples : 53 per pantograph), Lithium Base Grease No.3, Stores Item 5285EA.

A67. LUBRICATE D.B.V. AND I.B.V.

As per Westinghouse instructions.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

46 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

LUBRICATION SECTION.

A68. Spare 'A' Inspection.

A69. Spare 'A' Inspection.

A70. Spare 'A' Inspection.

B71. HANDBRAKE.

Lightly lubricate the handbrake pulley pivot pins with the hand oiler, using SAE.30 lube oil, Item 5255C.

B72. SUSPENSION BEARING LUBRICATOR PADS.

- (a) Clean around lubricator pad cover plate, remove cover.
- (b) Examine condition of pads, replace if required.
- (c) Replace cover using new cover plate gasket.

B73. Spare 'B' Inspection.

B74. Spare 'B' Inspection.

C75. WINDSCREEN WIPERS.

Lubricate parts in the air chamber with multi-purpose grease, Item 5285E.

C76. DRIVERS AND OBSERVERS SEATS.

Adjust mechanism and grease with Rocol Dry Lube M.I. 15514201.

C77. PEACOCK HANDBRAKE.

Remove cover, blow out dust and lightly lubricate with SAE.30 lube oil, Item 5255C. Lubricate handle mechanism.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

46 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

LUBRICATION SECTION.

C78. BRAKE CYLINDERS.

Grease all brake cylinder with grease gun. 12 pumps on pressure head and 2 pumps on gland end. Use Multi-purpose grease, Item 5285E.

C79. HASLER SPEEDOMETER TRANSMITTER.

Add multi-purpose grease, Item 5285E to both nipples. Remove the front cover of the gearbox to ensure sufficient grease has passed through the bearings and that adequate lubricant is contained in the gearbox.

C80. AIR COMPRESSOR OIL FILTER.

Remove element and thoroughly clean the filter bowl with clean lintless cloths. Ensure that no cloths are left in the filter bowl.

C81. AIR COMPRESSOR OIL CHANGE.

Drain sump and re-fill with SAE.30 lube oil, Item 5225C. Capacity 7.5 litres (13 pints).

After refilling, run the machine for a few minutes then top up the sump, if necessary, to make good the oil drawn into the filter and oilways.

C82. AIR COMPRESSOR MOTOR - (every second C Inspection).

Add four (4) pumps of Lithium Grease No.3, Item 5293A to motor bearings using a grease gun. DO NOT OVER LUBRICATE. Grease must not be allowed to enter the motor and any that passes the inner bearing cap must be carefully removed.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

46 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

LUBRICATION SECTION.

C83. BRAKE SLACK ADJUSTER BUSH.

NOT APPLICABLE.

C84. AXLE BOX ROLLER BEARINGS.

Grease roller bearing axlebox packaged units using a power operated grease gun filled with No.3 Lithium base grease, item 5293A. (Spec. No. L343/69).

Apply 450g (16 ounces) of grease per axlebox.

Grease nipples - Lincoln Part No. 5715 (1/2" N.P. thread), M.I. 47206065.

C85. TRACTION MOTOR SUSPENSION BEARING.

NOT APPLICABLE.

C86. MOTOR ALTERNATOR BEARING.

NOT APPLICABLE.

C87. Spare 'C' Inspection.

C88. Spare 'C' Inspection.

C89. Spare 'C' Inspection.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

46 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

AIR BRAKE SECTION.

NOTE: Items marked with an Asterisk (*) must also be performed after each Inspection.

T90. *VIGILANCE CONTROL EQUIPMENT.

Test vigilance control equipment in accordance with Circular No.41/66. Check that all seals are intact. Rectify and/or bring under notice of the Foreman any defects found during test.

T91. *AIR BRAKE EQUIPMENT.

Check:-

- (a) All brakeshoes must be 6 m.m. (1/4") above condemning.
- (b) Brake piston travel to be adjusted to minimum in accordance with Circular No.14/78.
- (c) Air compressor operation. main reservoir pressure to be maintained between 700-800 kPa (105-120 p.s.i.). Notify Foreman if it takes longer than ??????? to pump between those pressures.
- (d) Function of automatic and independent brake valves and flowmeters. See Circular No.95/61 as regards flowmeters.
- (e) Security of brake equipment, rectify all defects.
- (f) Leakage at piping and equipment, rectify all defects.
- (g) Drain condensate from all main reservoirs.
- (h) Check operation of handbrake. The Peacock ratchet handbrake must be operated with quick movements, to ensure function under emergency conditions.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

46 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

AIR BRAKE SECTION.

T92. Spare 'T' Inspection.

T93. Spare 'T' Inspection.

T94. Spare 'T' Inspection.

A95. SAFETY VALVES.

Check the operation and setting of the main reservoir safety valves.

Check all safety valves on the main reservoir and compressor intercooler for tightness.

A96. AIR COMPRESSOR AIR INTAKE FILTERS.

NOT APPLICABLE

A97. Spare 'A' Inspection.

A98. Spare 'A' Inspection.

A99. Spare 'A' Inspection.

A100. MAIN RESERVOIR AUTO DRAIN VALVE CHECK.

NOT APPLICABLE.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

46 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

AIR BRAKE SECTION.

B101.CHECK P AND C PRESSURE.

490 kPa (70 lb./in) adjusted by reducing valve between M.R. supply and P and C reservoir.

B102.COMPRESSOR GOVERNOR.

Clean and adjust to close at 105 lb./in² and open at 120 lb./in².
Compressor Governor Adjustment.

1. Set the higher pressure by adjusting the position of the top cap on the main (large) spring with the two vertical screws (keeping the plate horizontal), lowering the cap to increase the pressure setting.
2. The lower pressure is next set with the toggle spring, increasing the tension of the spring to increase the difference between the settings. As the bearings wear the amount of tension required in the toggle spring for the 15 lb./in² pressure difference will be reduced. This will reduce the tendency for the contacts to "snap" open and closed. When the toggle spring extension from free length is less than 1/16", wear in the mechanism is excessive and the governor is to be returned to Chullora for repair.

B103.CONTROL GOVERNOR.

Clean contacts and adjust to open at 50 lb./in² and close at 60 lb./in² check to see that contacts do not re-open as pressure builds up further.

B104.Spare 'B' Inspection.

B105.Spare 'B' Inspection.

B106.Spare 'B' Inspection.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

46 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

AIR BRAKE SECTION.

C107.AIR COMPRESSOR VALVES.

Remove valves, dismantle, clean and inspect.

Renew components where necessary. Replace reconditioned air compressor valves.

C108.AIR COMPRESSOR BREATHER.

Dismantle crankcase breather by removing the outer strainer plate, curled hair and inner strainer plate. Inspect plates, replace if necessary. Clean hair and re-assemble.

C109.AIR COMPRESSOR AIR FILTER.

Clean air compressor air intake strainer.

C110.COMPRESSOR INTERCOOLER AUTO DRAIN VALVE.

NOT APPLICABLE

C111.GAUGES.

Check calibration to a standard test gauge of:-

- (a) Control air pressure.
- (b) Air brake duplex (MR and ER) and (BP and B.Cyl.)
- (c) Flow meter gauge.

C112.AIR STRAINERS.

Remove and clean elements of air strainers in vigilance control, whistle valve, compressor governor control air, sanders and pantograph control air.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

46 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

AIR BRAKE SECTION.

C113.Spare 'C' Inspection.

C114.Spare 'C' Inspection.

C115.Spare 'C' Inspection.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

85 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

DRIVERS CABINS AND ENGINE ROOM SECTION.

T1. SANDS WHISTLES.

Check the operation of the following outside the shop:-

- (a) Sanders: Sand discharge per pipe 0.5 kg to 0.7 kg (1-1 1/2 lbs) per minute. Check pipe alignment - 40 m.m. (1 1/2") above rail level.
- (b) Whistles: Test both sides of cabs.

T2. LOG BOOK REPORT, GAUGES, WIPERS AND WASHERS.

In Driver's Cab, check:-

- (a) Log Book entries.
Attend to bookings as recorded by the Driver.
- (b) All gauge readings.
- (c) All windscreen wipers operation.
- (d) All windscreen washers operation, top up water container.

T3. HASLER SPEEDOMETER.

Wind clock and set hands if necessary.

Blue dot indicates p.m.

Check locomotive log book for kilometrage run since the last diagram roll change (anticipated life 3500 km). Change if required.

When installing or removing the roll, mark on the roll and in the top right hand corner of the Log Book the Locomotive number, Time, Date and relevant details.

NOTE: Reduce brake pipe pressure to zero with the automatic brake valve before closing the instrument case after installing a new roll to ensure the stylus for the brake line is correctly positioned.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

85 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

DRIVERS CABINS AND ENGINE ROOM SECTION.

T4. PHYSICAL INSPECTION.

Examine locomotive internally and externally for defects and fractures. Report any findings to Foreman.

T5. PANTO PANS AND CONDITION OF PANTOGRAPH.

Check the following:-

- (a) Shunts on pan knuckle and frame for tightness, overheating or damage.
- (b) Alignment of pans for twist.
- (c) Springs for breakage or weakness.
- (d) Pan supports for fracture.
- (e) Pistons for blow-by.
- (f) Saddles for loose pins and fractures.
- (g) Air hoses for leaking or signs of failure.
- (h) Check all insulators for damage.

Changing of Pans.

Change carbon strips when wear has occurred to 5/16" thickness from pan surface or if the strips are deeply grooved, severely chipped or securing bolts are loose.

T6. INSPECT SPARE EQUIPMENT BOX & SEALS.

NOT APPLICABLE.

T7. Spare 'T' Inspection.

T8. Spare 'T' Inspection.

T9. Spare 'T' Inspection.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

85 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

DRIVERS CABINS AND ENGINE ROOM SECTION.

A10. DOORS AND WINDOWS, ETC.

Check all cab, machine room and bulkhead doors; locks, hinges, seals, window frames.

Repair where required.

A11. ABLUTION TANK.

Fill tank.

NOTE: 85 class locomotives are equipped with stainless steel tanks and do not require any water treatment.

A12. PANTOGRAPH INSULATION.

Clean pantograph insulators using a cloth dampened in solvent. Do not use abrasive material.

A13. VORTACOOOL REFRIGERATOR.

Drain air filter on refrigerator air supply line. Pet cock located at the base of filter.

A14. Spare 'A' Inspection.

A15. Spare 'A' Inspection.

A16. Spare 'A' Inspection.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

85 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

DRIVERS CABINS AND ENGINE ROOM SECTION.

B17. PANTOGRAPH SPRING PRESSURE AND OPERATION.

Pantograph spring pressure is measured with a spring balance and should be 9.8 kg (22 lbs). Adjustment is made by increasing or decreasing, the length of the two main springs (equally on both sides).

The time of raising the pantograph should not exceed 20 seconds with a 3 foot maximum lift. If the time is exceeded, adjust the speed control which is located adjacent to the pantograph air cylinder.

When lowering the pantograph the quick release valve should function so that the pantograph leaves the wire quickly to reduce the effect of arcing. At a height of about 6" from the down position a cushioning effect should check the speed of the pantograph. If the cushioning occurs too soon or too late then adjustment is carried out by means of the fitting at the centre of the pressure head of the air cylinder.

B18. PANTOGRAPH HAND/FOOT PUMP.

Drain all air from main reservoirs, check operation of hand pump by using pump to raise pantograph. Replace pump if defective.

B19. RAISE AND LOWER VALVE.

NOT APPLICABLE.

B20. Spare 'B' Inspection.

B21. Spare 'B' Inspection.

B22. Spare 'B' Inspection.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

85 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

DRIVERS CABINS AND ENGINE ROOM SECTION.

C23. HOLDING DOWN BOLTS.

Check the tightness of the following:-

Traction motor blower housing.

C24. TRACTION MOTOR BLOWER IMPELLERS.

Inspect impeller for defects.

Remove any deposits on the impellers, if necessary. Clean in situ.
Cover lower blades with cleaning cloths and exercise care in not
allowing foreign matter into the air passages.

C25. VORTACOOOL REFRIGERATION.

Remove and clean filter bowl.

Fit new sintered bronze filter element (M.I. 13009253)

Renew filter bowl gasket (M.I. 13176052)

C26. PANTO 3 WAY COCK.

NOT APPLICABLE.

C27. Spare 'C' Inspection.

C28. Spare 'C' Inspection.

C29. Spare 'C' Inspection.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

85 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

UNDERNEATH LOCOMOTIVE SECTION.

T30. TRACTION MOTOR COOLING AIRFLOW.

Check the cooling air flow from the traction motors.

Check the cooling air flow through the air compressor cylinder heads.

Examine the air bellows, wear plates and arms for alignment, leakage and damage. Ensure setscrews are tight.

T31. TRACTION MOTOR NOSE SUSPENSION.

Check the traction motor nose suspension assemblies and wear plates.

Refer to Item 11 in Appendix A, Page AX20.

T32. HASLER TRANSMITTER AND SPEED GENERATORS.

Check the security of the Hasler transmitter and speed generators on the axlebox cover.

T33. BOLSTER MOUNTING PADS.

Visually check the condition of the bolster mounting pads rubber and steel laminations.

T34. WHEEL EXAMINATION.

All wheel flanges to be examined for arrised condition and corrected if required.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

85 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

UNDERNEATH LOCOMOTIVE SECTION.

T35. SHOCK ABSORBER.

Check condition of shock absorbers and anchor points.

T36. EXAMINE BOGIES FOR LOOSE OR BROKEN PARTS.

NOT APPLICABLE.

T37. Spare 'T' Inspection.

T38. Spare 'T' Inspection.

T39. Spare 'T' Inspection.

T40. AUTOMATIC COUPLERS.

Check auto coupler height 865 m.m. +/- 25 m.m. (34" +/-1") measured from rail level to the centre line of the coupler knuckle.

Refer to Item 13 in Appendix A, Page AX23.

Gauge auto couplers at both ends.

T41. SHOCK ABSORBERS.

Check bolts for tightness. Renew rubbers on bolts if worn or badly spread.

T42. COMPRESSOR SEALS AND FLEXIBLE DRIVES.

NOT APPLICABLE.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

85 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

UNDERNEATH LOCOMOTIVE SECTION.

A43. Spare 'A' Inspection.

A44. Spare 'A' Inspection.

A45. Spare 'A' Inspection.

B46. BOGIES.

Check all nuts for tightness and that all split pins and cotters are split.

B47. AIR COMPRESSOR MOUNTINGS.

Examine Silentbloc Mountings on air compressor.

B48. Spare 'B' Inspection.

B49. Spare 'B' Inspection.

B50. Spare 'B' Inspection.

C51. SUSPENSION BEARING BOLTS.

NOT APPLICABLE.

C52. Spare 'C' Inspection.

C53. Spare 'C' Inspection.

C54. Spare 'C' Inspection.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

85 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

LUBRICATION SECTION.

T55. AIR COMPRESSOR OIL LEVEL.

With the compressor stopped, check the air compressor's lube oil level. Replenish with SAE.30 lube oil, Item 5255C.

Check gaskets and inspection covers for oil leaks.

T56. TRACTION MOTOR GEARCASES.

Add lubricant as necessary to maintain a heavy film on gear teeth.

For gearcases with inspection plugs or covers, maintain lubricant level at the bottom of the inspection plug hole.

Use Caltex Gear Lube T.M. 7500, M.I. 26819904, in 450g (1 lb.) white polyethylene bags.

T57. GREASE BOGIE AS REQUIRED.

NOT APPLICABLE.

T58. SUSPENSION BEARING OIL LEVEL.

NOT APPLICABLE.

T59. Spare 'T' Inspection.

T60. Spare 'T' Inspection.

T61. Spare 'T' Inspection.

A62. DOOR AND WINDOW HARDWARE.

Lightly lubricate hinges, lock, slides, etc.

Use Rocol M.I. 15514201.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

85 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

LUBRICATION SECTION.

A63. AIR COCKS AT HEADSTOCK.

Check all cocks for freedom of movement and that there is some resistance to movement. Grease where necessary with multi-purpose grease, Item E.

NOTE: Springs on 18 m.m. (3/4") and 25 m.m. (1") cocks are to have 4.5 m.m. (3/16") compression. Springs on 12.5 m.m. (1/2") cocks are to have 3 m.m. (1/8") compression. Ball type cocks are not to be fitted.

A64. BRAKE RIGGING.

Lightly lubricate pins and bushings with hand oiler. Use SAE.30 lube oil, Item 5255C.

A65. BRAKE SLACK ADJUSTERS.

Clean brake slack adjusters with wire brush and renew defective split pins. Split at 45°.

Apply Rocol Dry Film, M.I. 70019005, to screw thread.

A66. GREASE PANTOGRAPHS.

Grease as required.

A67. LUBRICATE D.B.V. AND I.B.V.

NOT APPLICABLE.

A68. Spare 'A' Inspection.

A69. Spare 'A' Inspection.

A70. Spare 'A' Inspection.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

85 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

LUBRICATION SECTION.

B71. HANDBRAKE.

Lightly lubricate the handbrake pulley pivot pins with the hand oiler, using SAE.30 lube oil, Item 5255C.

B72. SUSPENSION BEARING LUBRICATOR PADS.

NOT APPLICABLE.

B73. Spare 'B' Inspection.

B74. Spare 'B' Inspection.

C75. WINDSCREEN WIPERS.

Lubricate parts in the air chamber with multi-purpose grease, Item 5285E.

C76. DRIVERS AND OBSERVERS SEATS.

Adjust mechanism and grease with Rocol Dry Lube M.I. 15514201.

C77. PEACOCK HANDBRAKE.

Remove cover, blow out dust and lightly lubricate with SAE.30 lube oil, Item 5255C. Lubricate handle mechanism.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

85 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

LUBRICATION SECTION.

C78. BRAKE CYLINDERS.

Grease all brake cylinder with grease gun. 12 pumps on pressure head and 2 pumps on gland end. Use Multi-purpose grease, Item 5285E.

C79. HASLER SPEEDOMETER TRANSMITTER.

Add multi-purpose grease, Item 5285E to both nipples. Remove the front cover of the gearbox to ensure sufficient grease has passed through the bearings and that adequate lubricant is contained in the gearbox.

C80. AIR COMPRESSOR OIL FILTER.

Remove element and thoroughly clean the filter bowl with clean lintless cloths. Ensure that no cloths are left in the filter bowl.

Renew the filter element M.I. 20313250.

C81. AIR COMPRESSOR OIL CHANGE.

Drain sump and re-fill with SAE.30 lube oil, Item 5225C. Capacity 7.5 litres (13 pints).

After refilling, run the machine for a few minutes then top up the sump, if necessary, to make good the oil drawn into the filter and oilways.

C82. AIR COMPRESSOR MOTOR - (every second C Inspection).

Add four (4) pumps of Lithium Grease No.3, Item 5293A to motor bearings using a grease gun. DO NOT OVER LUBRICATE. Grease must not be allowed to enter the motor and any that passes the inner bearing cap must be carefully removed.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

85 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

LUBRICATION SECTION.

C83. BRAKE SLACK ADJUSTER BUSH.

Grease brake slack adjuster bush.

Use multi-purpose grease, Item 5285E.

C84. AXLE BOX ROLLER BEARINGS.

Grease roller bearing axlebox packaged units using a power operated grease gun filled with No.3 Lithium base grease, item 5293A. (Spec. No. L343/69).

Apply 450g (16 ounces) of grease per axlebox.

Grease nipples - Lincoln Part No. 5715 (1/2" N.P. thread), M.I. 47206065.

C85. TRACTION MOTOR SUSPENSION BEARING - (every second C inspection).

Gear side. Grease with Shell Alvania Grease No.3 - 0.3 kg Item 5293A.

Commutator Side. Grease with Shell Alvania Grease No.3 - 0.3 kg Item 5293A.

C86. MOTOR ALTERNATOR BEARING - (every second C inspection).

Gear side. Grease with Shell Alvania Grease No.3 - 50 grams Item 5293A.

Commutator Side. Grease with Shell Alvania Grease No.3 - 50 grams Item 5293A.

C87. Spare 'C' Inspection.

C88. Spare 'C' Inspection.

C89. Spare 'C' Inspection.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

85 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

AIR BRAKE SECTION.

NOTE: Items marked with an Asterisk (*) must also be performed after each Inspection.

T90. *VIGILANCE CONTROL EQUIPMENT.

Test vigilance control equipment in accordance with Circular No.41/66. Check that all seals are intact. Rectify and/or bring under notice of the Foreman any defects found during test.

T91. *AIR BRAKE EQUIPMENT.

Check:-

- (a) All brakeshoes must be 6 m.m. (1/4") above condemning.
- (b) Brake piston travel to be adjusted to minimum in accordance with Circular No.14/78.
- (c) Air compressor operation. main reservoir pressure to be maintained between 700-800 kPa (105-120 p.s.i.). Notify Foreman if it takes longer than ??????? to pump between those pressures.
- (d) Function of automatic and independent brake valves and flowmeters. See Circular No.95/61 as regards flowmeters.
- (e) Security of brake equipment, rectify all defects.
- (f) Leakage at piping and equipment, rectify all defects.
- (g) Drain condensate from all main reservoirs.
- (h) Check operation of handbrake. The Peacock ratchet handbrake must be operated with quick movements, to ensure function under emergency conditions.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

85 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

AIR BRAKE SECTION.

T92. Spare 'T' Inspection.

T93. Spare 'T' Inspection.

T94. Spare 'T' Inspection.

A95. SAFETY VALVES.

Check the operation and setting of the main reservoir safety valves.

Check all safety valves on the main reservoir and compressor intercooler for tightness.

A96. AIR COMPRESSOR AIR INTAKE FILTERS.

Remove excessive dirt from filter element by tapping gently against a clean solid object.

A97. Spare 'A' Inspection.

A98. Spare 'A' Inspection.

A99. Spare 'A' Inspection.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

85 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

AIR BRAKE SECTION.

B100.MAIN RESERVOIR AUTO DRAIN VALVE CHECK.

Check operation of automatic drain valves on main reservoir.

B101.CHECK P AND C PRESSURE.

NOT APPLICABLE.

B102.COMPRESSOR GOVERNOR.

NOT APPLICABLE.

B103.CONTROL GOVERNOR.

NOT APPLICABLE.

B104.Spare 'B' Inspection.

B105.Spare 'B' Inspection.

B106.Spare 'B' Inspection.

C107.AIR COMPRESSOR VALVES.

Remove valves, dismantle, clean and inspect.

Renew components where necessary. Replace reconditioned air compressor valves.

C108.AIR COMPRESSOR BREATHER.

Dismantle crankcase breather by removing the outer strainer plate, curled hair and inner strainer plate. Inspect plates, replace if necessary. Clean hair and re-assemble.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

85 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

AIR BRAKE SECTION.

C109.AIR COMPRESSOR AIR FILTER.

Clean air compressor air intake filter element, M.I. 20314373.

C110.COMPRESSOR INTERCOOLER AUTO DRAIN VALVE.

Remove and dismantle auto drain valve. Clean all parts paying particular attention to the nipple and strainer assembly. Examine all parts for signs of wear or damage, renew parts as necessary. Inspect spring for sign of corrosion or having taken a permanent set. Free height of spring when new 37.3 m.m. (1 and 15/32").

C111.GAUGES.

Check calibration to a standard test gauge of:-

- (a) Control air pressure.
- (b) Air brake duplex (MR and ER) and (BP and B.Cyl.)
- (c) Flow meter gauge.

C112.AIR STRAINERS.

Remove and clean elements of air strainers in vigilance control, whistle valve, compressor governor control air, sanders and pantograph control air.

C113.Spare 'C' Inspection.

C114.Spare 'C' Inspection.

C115.Spare 'C' Inspection.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

86 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

DRIVERS CABINS AND ENGINE ROOM SECTION.

T1. SANDS WHISTLES.

Check the operation of the following outside the shop:-

- (a) Sanders: Sand discharge per pipe 0.5 kg to 0.7 kg (1-1 1/2 lbs) per minute. Check pipe alignment - 40 m.m. (1 1/2") above rail level.
- (b) Whistles: Test both sides of cabs.

T2. LOG BOOK REPORT, GAUGES, WIPERS AND WASHERS.

In Driver's Cab, check:-

- (a) Log Book entries.
Attend to bookings as recorded by the Driver.
- (b) All gauge readings.
- (c) All windscreen wipers operation.
- (d) All windscreen washers operation, top up water container.

T3. HASLER SPEEDOMETER.

Wind clock and set hands if necessary.

Blue dot indicates p.m.

Check locomotive log book for kilometrage run since the last diagram roll change (anticipated life 3500 km). Change if required.

When installing or removing the roll, mark on the roll and in the top right hand corner of the Log Book the Locomotive number, Time, Date and relevant details.

NOTE: Reduce brake pipe pressure to zero with the automatic brake valve before closing the instrument case after installing a new roll to ensure the stylus for the brake line is correctly positioned.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

86 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

DRIVERS CABINS AND ENGINE ROOM SECTION.

T4. PHYSICAL INSPECTION.

Examine locomotive internally and externally for defects and fractures. Report any findings to Foreman.

T5. PANTO PANS AND CONDITION OF PANTOGRAPH.

Check the following:-

- (a) Shunts on pan knuckle and frame for tightness, overheating or damage.
- (b) Alignment of pans for twist.
- (c) Springs for breakage or weakness.
- (d) Pan supports for fracture.
- (e) Pistons for blow-by.
- (f) Saddles for loose pins and fractures.
- (g) Air hoses for leaking or signs of failure.
- (h) Check all insulators for damage.

Changing of Pans.

Change carbon strips when wear has occurred to 5/16" thickness from pan surface or if the strips are deeply grooved, severely chipped or securing bolts are loose.

T6. INSPECT SPARE EQUIPMENT BOX & SEALS.

NOT APPLICABLE.

T7. Spare 'T' Inspection.

T8. Spare 'T' Inspection.

T9. Spare 'T' Inspection.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

86 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

DRIVERS CABINS AND ENGINE ROOM SECTION.

A10. DOORS AND WINDOWS, ETC.

Check all cab, machine room and bulkhead doors; locks, hinges, seals, window frames.

Repair where required.

A11. ABLUTION TANK.

Fill tank.

NOTE: 86 class locomotives are equipped with stainless steel tanks and do not require any water treatment.

A12. PANTOGRAPH INSULATION.

Clean pantograph insulators using a cloth dampened in solvent. Do not use abrasive material.

A13. VORTACOOOL REFRIGERATOR.

Drain air filter on refrigerator air supply line. Pet cock located at the base of filter.

A14. Spare 'A' Inspection.

A15. Spare 'A' Inspection.

A16. Spare 'A' Inspection.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

86 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

DRIVERS CABINS AND ENGINE ROOM SECTION.

B17. PANTOGRAPH SPRING PRESSURE AND OPERATION.

Pantograph spring pressure is measured with a spring balance and should be 9.8 kg (22 lbs). Adjustment is made by increasing or decreasing, the length of the two main springs (equally on both sides).

The time of raising the pantograph should not exceed 20 seconds with a 3 foot maximum lift. If the time is exceeded, adjust the speed control which is located adjacent to the pantograph air cylinder.

When lowering the pantograph the quick release valve should function so that the pantograph leaves the wire quickly to reduce the effect of arcing. At a height of about 6" from the down position a cushioning effect should check the speed of the pantograph. If the cushioning occurs too soon or too late then adjustment is carried out by means of the fitting at the centre of the pressure head of the air cylinder.

B18. PANTOGRAPH HAND/FOOT PUMP.

Drain all air from main reservoirs, check operation of hand pump by using pump to raise pantograph. Replace pump if defective.

B19. RAISE AND LOWER VALVE.

NOT APPLICABLE.

B20. Spare 'B' Inspection.

B21. Spare 'B' Inspection.

B22. Spare 'B' Inspection.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

86 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

DRIVERS CABINS AND ENGINE ROOM SECTION.

C23. HOLDING DOWN BOLTS.

Check the tightness of the following:-

Traction motor blower housing.

C24. TRACTION MOTOR BLOWER IMPELLERS.

Inspect impeller for defects.

Remove any deposits on the impellers, if necessary. Clean in situ.
Cover lower blades with cleaning cloths and exercise care in not
allowing foreign matter into the air passages.

C25. VORTACOOOL REFRIGERATION.

Remove and clean filter bowl.

Fit new sintered bronze filter element (M.I. 13009253)

Renew filter bowl gasket (M.I. 13176052)

C26. PANTO 3 WAY COCK.

NOT APPLICABLE.

C27. Spare 'C' Inspection.

C28. Spare 'C' Inspection.

C29. Spare 'C' Inspection.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

86 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

UNDERNEATH LOCOMOTIVE SECTION.

T30. TRACTION MOTOR COOLING AIRFLOW.

Check the cooling air flow from the traction motors.

Check the cooling air flow through the air compressor cylinder heads.

Examine the air bellows, wear plates and arms for alignment, leakage and damage. Ensure setscrews are tight.

T31. TRACTION MOTOR NOSE SUSPENSION.

Check the traction motor nose suspension assemblies and wear plates.

Refer to Item 11 in Appendix A, Page AX20.

T32. HASLER TRANSMITTER AND SPEED GENERATORS.

Check the security of the Hasler transmitter and speed generators on the axlebox cover.

T33. BOLSTER MOUNTING PADS.

Visually check the condition of the bolster mounting pads rubber and steel laminations.

T34. WHEEL EXAMINATION.

All wheel flanges to be examined for arrised condition and corrected if required.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

86 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

UNDERNEATH LOCOMOTIVE SECTION.

T35. SHOCK ABSORBER.

Check condition of shock absorbers and anchor points.

T36. EXAMINE BOGIES FOR LOOSE OR BROKEN PARTS.

NOT APPLICABLE.

T37. Spare 'T' Inspection.

T38. Spare 'T' Inspection.

T39. Spare 'T' Inspection.

T40. AUTOMATIC COUPLERS.

Check auto coupler height 865 m.m. +/- 25 m.m. (34" +/-1") measured from rail level to the centre line of the coupler knuckle.

Refer to Item 13 in Appendix A, Page AX23.

Gauge auto couplers at both ends.

T41. SHOCK ABSORBERS.

Check bolts for tightness. Renew rubbers on bolts if worn or badly spread.

T42. COMPRESSOR SEALS AND FLEXIBLE DRIVES.

NOT APPLICABLE.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

86 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

UNDERNEATH LOCOMOTIVE SECTION.

A43. Spare 'A' Inspection.

A44. Spare 'A' Inspection.

A45. Spare 'A' Inspection.

B46. BOGIES.

Check all nuts for tightness and that all split pins and cotters are split.

B47. AIR COMPRESSOR MOUNTINGS.

Examine Silentbloc Mountings on air compressor.

B48. Spare 'B' Inspection.

B49. Spare 'B' Inspection.

B50. Spare 'B' Inspection.

C51. SUSPENSION BEARING BOLTS.

NOT APPLICABLE.

C52. Spare 'C' Inspection.

C53. Spare 'C' Inspection.

C54. Spare 'C' Inspection.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

86 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

LUBRICATION SECTION.

T55. AIR COMPRESSOR OIL LEVEL.

With the compressor stopped, check the air compressor's lube oil level. Replenish with compressor oil medium, ISO 100, Item 5268.

Check gaskets and inspection covers for oil leaks.

T56. TRACTION MOTOR GEARCASES.

Add lubricant as necessary to maintain a heavy film on gear teeth.

For gearcases with inspection plugs or covers, maintain lubricant level at the bottom of the inspection plug hole.

Use Caltex Gear Lube T.M. 7500, M.I. 26819904, in 450g (1 lb.) white polyethylene bags.

T57. GREASE BOGIE AS REQUIRED.

NOT APPLICABLE.

T58. SUSPENSION BEARING OIL LEVEL.

NOT APPLICABLE.

T59. Spare 'T' Inspection.

T60. Spare 'T' Inspection.

T61. Spare 'T' Inspection.

A62. DOOR AND WINDOW HARDWARE.

Lightly lubricate hinges, lock, slides, etc.

Use Rocol M.I. 15514201.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

86 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

LUBRICATION SECTION.

A63. AIR COCKS AT HEADSTOCK.

Check all cocks for freedom of movement and that there is some resistance to movement. Grease where necessary with multi-purpose grease, Item 5285E.

NOTE: Springs on 18 m.m. (3/4") and 25 m.m. (1") cocks are to have 4.5 m.m. (3/16") compression. Springs on 12.5 m.m. (1/2") cocks are to have 3 m.m. (1/8") compression. Ball type cocks are not to be fitted.

A64. BRAKE RIGGING.

Lightly lubricate pins and bushings with hand oiler. Use SAE.30 lube oil, Item 5255C.

A65. BRAKE SLACK ADJUSTERS.

Clean brake slack adjusters with wire brush and renew defective split pins. Split at 45°.

Apply Rocol Dry Film, M.I. 70019005, to screw thread.

A66. GREASE PANTOGRAPHS.

Grease as required.

A67. LUBRICATE D.B.V. AND I.B.V.

NOT APPLICABLE.

A68. WHEEL FLANGE LUBRICATORS

- (a) Top up all lubricant reservoirs.
- (b) Clean all nozzles with a wire brush, rag and solvent.
- (c) Clean water separator and filter (air supply).
- (d) Check spray nozzle adjustment distances using correct gauge. If these are more than 10 m.m. different from those indicated on gauge adjust accordingly.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

86 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

LUBRICATION SECTION.

- (e) Check operation of lubricators by setting the "Test Switch" of the control unit on "Test" position. Ensure that oil is coming from each nozzle and that the oil spray pattern is well located on the flange.

NOTE: Do not forget to reset the test switch to "Normal" position.

- (f) Check all air and oil pipes for leaks (pay particular attention to flexible hoses and connections).

A69. Spare 'A' Inspection.

A70. Spare 'A' Inspection.

B71. HANDBRAKE.

Lightly lubricate the handbrake pulley pivot pins with the hand oiler, using SAE.30 lube oil, Item 5255C.

B72. SUSPENSION BEARING LUBRICATOR PADS.

NOT APPLICABLE.

B73. Spare 'B' Inspection.

B74. Spare 'B' Inspection.

C75. WINDSCREEN WIPERS.

Lubricate parts in the air chamber with multi-purpose grease, Item 5285E.

C76. DRIVERS AND OBSERVERS SEATS.

Adjust mechanism and grease with Rocol Dry Lube M.I. 15514201.

C77. PEACOCK HANDBRAKE.

Remove cover, blow out dust and lightly lubricate with SAE.30 lube oil, Item 5255C. Lubricate handle mechanism.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

86 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

LUBRICATION SECTION.

C78. BRAKE CYLINDERS.

Grease all brake cylinder with grease gun. 12 pumps on pressure head and 2 pumps on gland end. Use Multi-purpose grease, Item 5285E.

C79. HASLER SPEEDOMETER TRANSMITTER.

Add multi-purpose grease, Item 5285E to both nipples. Remove the front cover of the gearbox to ensure sufficient grease has passed through the bearings and that adequate lubricant is contained in the gearbox.

C80. AIR COMPRESSOR OIL FILTER.

Remove element and thoroughly clean the filter bowl with clean lintless cloths. Ensure that no cloths are left in the filter bowl.

Renew the filter element M.I. 20313250.

C81. AIR COMPRESSOR OIL CHANGE.

Drain sump and re-fill with compressor oil medium, ISO 100, Item 5268. Capacity 7.5 litres (13 pints).

After refilling, run the machine for a few minutes then top up the sump, if necessary, to make good the oil drawn into the filter and oilways.

C82. AIR COMPRESSOR MOTOR - (every second C Inspection).

Add four (4) pumps of Lithium Grease No.3, Item 5293A to motor bearings using a grease gun. DO NOT OVER LUBRICATE. Grease must not be allowed to enter the motor and any that passes the inner bearing cap must be carefully removed.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

86 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

LUBRICATION SECTION.

C83. BRAKE SLACK ADJUSTER BUSH.

Grease brake slack adjuster bush.

Use multi-purpose grease, Item 5285E.

C84. AXLE BOX ROLLER BEARINGS.

Grease roller bearing axlebox packaged units using a power operated grease gun filled with No.3 Lithium base grease, item 5293A. (Spec. No. L343/69).

Apply 450g (16 ounces) of grease per axlebox.

Grease nipples - Lincoln Part No. 5715 (1/2" N.P. thread), M.I. 47206065.

C85. TRACTION MOTOR SUSPENSION BEARING - (every second C inspection).

Gear side. Grease with Shell Alvania Grease No.3 - 0.3 kg Item 5293A.

Commutator Side. Grease with Shell Alvania Grease No.3 - 0.3 kg Item 5293A.

C86. MOTOR ALTERNATOR BEARING - (every second C inspection).

Gear side. Grease with Shell Alvania Grease No.3 - 50 grams Item 5293A.

Commutator Side. Grease with Shell Alvania Grease No.3 - 50 grams Item 5293A.

C87. SPRING PARKING BRAKE.

Grease all spring parking brake cylinders with grease gun. 12 pumps on pressure head and two pumps on gland end. Use multi-purpose grease, Item 5285E.

C88. Spare 'C' Inspection.

C89. Spare 'C' Inspection.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

86 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

AIR BRAKE SECTION.

NOTE: Items marked with an Asterisk (*) must also be performed after each Inspection.

T90. *VIGILANCE CONTROL EQUIPMENT.

Test vigilance control equipment in accordance with Circular No.41/66. Check that all seals are intact. Rectify and/or bring under notice of the Foreman any defects found during test.

T91. *AIR BRAKE EQUIPMENT.

Check:-

- (a) All brakeshoes must be 6 m.m. (1/4") above condemning.
- (b) Brake piston travel to be adjusted to minimum in accordance with Circular No.14/78.
- (c) Air compressor operation. main reservoir pressure to be maintained between 700-800 kPa (105-120 p.s.i.). Notify Foreman if it takes longer than ??????? to pump between those pressures.
- (d) Function of automatic and independent brake valves and flowmeters. See Circular No.95/61 as regards flowmeters.
- (e) Security of brake equipment, rectify all defects.
- (f) Leakage at piping and equipment, rectify all defects.
- (g) Drain condensate from all main reservoirs.
- (h) Check operation of handbrake. The Peacock ratchet handbrake must be operated with quick movements, to ensure function under emergency conditions.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

86 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

AIR BRAKE SECTION.

T92. Spare 'T' Inspection.

T93. Spare 'T' Inspection.

T94. Spare 'T' Inspection.

A95. SAFETY VALVES.

Check the operation and setting of the main reservoir safety valves.

Check all safety valves on the main reservoir and compressor intercooler for tightness.

A96. AIR COMPRESSOR AIR INTAKE FILTERS.

Remove excessive dirt from filter element by tapping gently against a clean solid object.

A97. Spare 'A' Inspection.

A98. Spare 'A' Inspection.

A99. Spare 'A' Inspection.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

86 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

AIR BRAKE SECTION.

B100.MAIN RESERVOIR AUTO DRAIN VALVE CHECK.

Check operation of automatic drain valves on main reservoir.

B101.CHECK P AND C PRESSURE.

NOT APPLICABLE.

B102.COMPRESSOR GOVERNOR.

NOT APPLICABLE.

B103.CONTROL GOVERNOR.

NOT APPLICABLE.

B104.Spare 'B' Inspection.

B105.Spare 'B' Inspection.

B106.Spare 'B' Inspection.

C107.AIR COMPRESSOR VALVES.

Remove valves, dismantle, clean and inspect.

Renew components where necessary. Replace reconditioned air compressor valves.

C108.AIR COMPRESSOR BREATHER.

Dismantle crankcase breather by removing the outer strainer plate, curled hair and inner strainer plate. Inspect plates, replace if necessary. Clean hair and re-assemble.

STATE RAIL AUTHORITY OF NEW SOUTH WALES.

MECHANICAL INSPECTION SCHEDULE.

86 CLASS - 2700 KW (3600 HP) ELECTRIC LOCOMOTIVES.

AIR BRAKE SECTION.

C109.AIR COMPRESSOR AIR FILTER.

Clean air compressor air intake filter element, M.I. 20314373.

C110.COMPRESSOR INTERCOOLER AUTO DRAIN VALVE.

Remove and dismantle auto drain valve. Clean all parts paying particular attention to the nipple and strainer assembly. Examine all parts for signs of wear or damage, renew parts as necessary. Inspect spring for sign of corrosion or having taken a permanent set. Free height of spring when new 37.3 m.m. (1 and 15/32").

C111.GAUGES.

Check calibration to a standard test gauge of:-

- (a) Control air pressure.
- (b) Air brake duplex (MR and ER) and (BP and B.Cyl.)
- (c) Flow meter gauge.

C112.AIR STRAINERS.

Remove and clean elements of air strainers in vigilance control, whistle valve, compressor governor control air, sanders and pantograph control air.

C113.Spare 'C' Inspection.

C114.Spare 'C' Inspection.

C115.Spare 'C' Inspection.

PUBLIC TRANSPORT COMMISSION OF NEW SOUTH WALES

ELECTRIC LOCOMOTIVES

MECHANICAL AND ELECTRICAL MAINTENANCE

MECHANICAL AND ELECTRICAL MAINTENANCE SCHEDULES

MANUAL NO. _____

NAME : _____

LOCATION: _____

INTRODUCTION

This manual contains the Mechanical and Electrical Schedules for trip, A, B, and C inspections for both classes of electric locomotives.

The system adopted, with the introduction of these sheets, is entirely different from the previous method, resulting in all existing mechanical and electrical inspection schedules being superseded.

The new system operates in the following manner:

<u>TRIP INSPECTION</u>	6 DAYS
<u>'A' INSPECTION</u>	45 DAYS
<u>'B' INSPECTION</u>	135 DAYS
<u>'C' INSPECTION</u>	270 DAYS

The sequence of inspections should be AABAAC.

The new sheet designed "M-TRIP" should be issued for each Mechanical trip inspection and when completed, attached to the "GREEN" log book sheets, for filing in the depot records section at Delec.

For A, B and C Mechanical inspections one sheet only is issued, designated 'MI' and printed on blue paper. This "BLUE" sheet, lists all items which require attention on the particular inspection being performed. The Fitter assigned to the job is required to sign for each item individually. The "BLUE" sheet is attached to the "GREEN" log book sheets and returned to the Sub-Foreman for signature.

The sheet 'M1' contains only sub headings of the equipment requiring attention. For a complete explanation of the correct maintenance procedures, reference to the item concerned should be made in the master sheets.

The master sheets are bound in order and the procedure can be found by referring to the master sheet item number corresponding to the item number on sheet 'M1'.

The 'Remarks' section on the sheet 'M1' should contain information relative to the repair or replacement of equipment.

These sheets are then forwarded to the records section at the Delec.

Inevitably changes will take place on inspection schedules, so from time to time amendments will be sent through the mail. It will be your responsibility to replace superseded sheets and so keep this manual current.

This manual is an initial issue and any suggestions towards its improvement would be appreciated, also any enquiry regarding the interpretation or requirements will be dealt with if directed to the Assistant to the Senior Engineer, Electric Traction, Room 5, Chief Mechanical Engineer's Office, Redfern, telephone No. 9.7016.

* * * *

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September, 1971
M-Trip

DEPARTMENT OF RAILWAYS - NEW SOUTH WALES
46 CLASS ELECTRIC LOCOMOTIVES
MECHANICAL TRIP INSPECTIONS

Item Numbers correspond to numbers on Master Sheet.

UNIT NO. _____ DEPOT _____ DATE _____

NO.	ITEM	SIGNATURE
1.	Log Book Report	_____
2.	Vigilance Control	_____
3.	Test auto, independent brakes	_____
4.	Wind Hasler Clock and check chart	_____
5.	Check panto pans and condition of pantograph	_____
6.	Examine bogies for loose or broken parts.	_____
7.	Tyres and wheels	_____
8.	Examine brake shoes	_____
9.	Drain reservoirs	_____
10.	Inspect spare equipment box and seals	_____
11.	Suspension bearings and gear case oil level	_____
12.	Compressor oil level	_____
13.	Grease bogie grease points as required	_____

REMARKS:

SIGNATURE OF SUB-FOREMAN

DEPARTMENT OF RAILWAYS - NEW SOUTH WALES
46 CLASS ELECTRIC LOCOMOTIVES
MECHANICAL INSPECTIONS

This sheet issued for Trip - Items 1 - 13
A - Items 1 - 21
B - Items 1 - 33
C - Items 1 - 38

UNIT NO. _____ DEPOT _____ DATE _____

NO.	ITEM	SIGNATURE	NO.	ITEM	SIGNATURE
1.	Log Book report	_____	8.	Examine brake shoes	_____
2.	Vigilance control	_____	9.	Drain reservoirs	_____
3.	Test auto independent	_____	10.	Inspect spare equipment box and seals and detonator containers and seals.	_____
4.	Wind Hasler clock and check chart.	_____	11.	Suspension bearing and gear case oil level.	_____
5.	Check panto pans and condition of pantograph	_____	12.	Compressor oil level.	_____
6.	Examine bogies for loose or broken parts.	_____	13.	Grease bogie grease points as required.	_____
7.	Tyres and wheels	_____			
14.	Grease pantographs	_____	18.	Check bogies	_____
15.	Lubricate D.B.V. and I.B.V.	_____	19.	Compressor seals and flexible drives.	_____
16.	Door catches and hinges	_____	20.	Traction motor air ducts	_____
17.	Whistle and wiper valves	_____	21.	Check hand brake	_____
22.	Clean whistle and wiper valves.	_____	28.	Panto hand pump clean and grease.	_____
23.	Clean air strainers	_____	29.	Raise and lower valve.	_____
24.	Check slack adjusters	_____	30.	Check flow indicators.	_____
25.	Examine brake pipe feed valve.	_____	31.	Check compressor governor	_____
26.	Check P and C pressure.	_____	32.	Check control governor.	_____
27.	Check panto spring pressure and operation.	_____	33.	Compressor oil pump and filter.	_____
34.	Suspension bearing bolts	_____	37.	Brake cylinders	_____
35.	Compressor cylinder heads	_____	38.	Panto three (3) way cock	_____
36.	Examine compressor valves	_____			

REMARKS:

SIGNATURE OF SUB-FOREMAN _____

Item 1 Log Book Report:

Attend to all work reported by driver. In the event of repairs not being carried out due to shortage of material etc., carry forward the particular booking for attention at the next trip inspection.

Sign off all mechanical work on green sheets in log book. (Sheets to be removed at Delec only).

Item 2 Vigilance Control:

See instructions C.M.E. 41/66.

Item 3 Test Auto and Independent Brakes:

See Westinghouse instructions.

Item 4 Wind Hasler Clock and Check Chart:

A line appears on chart when paper is approaching the end of reel, replace if this is showing.

Item 5 Check Panto Pans and Condition of Pantograph:

Check (a) shunts on pan, knuckle and frame for tightness, overheating or damage.
(b) Alignment of pans for twist.
(c) Saddles for loose pins and fractures.
(d) Springs for breakage or weakness.
(e) Pan supports for fractures.
(f) Pistons for blowing.
(g) Air hoses for leaking or signs of failure.
(h) Paint with graphite grease M.I. 2684500, thinned with lacquer thinners, Stores item 4348, if copper strips are fitted.

Changing of Pans:

Where copper strips are fitted the pans need changing when worn to condemning edge.

Change carbon strips when wear has occurred to 5/16" thickness from pan surface or if strips are deeply grooved, severely chipped or securing bolts are loose.

Item 6 Examine Bogies for Loose or Broken Parts:

Check sand pipe alignment and discharge, auto couplers and draft gear, coil and leaf springs, compensating link pins and associated equipment for breakage, misalignment, etc.

Item 7 Tyres and Wheels:

Examine for fractures, shelling or flaking in tyres and loose or broken rivets, skidded wheels, deep tyres, sharp flanges, etc.

Item 8 Examine Brake Shoes:

Replace when worn to condemning notch re-adjust rigging as required.

Item 9 Drain Reservoirs:

Compressor intercooler, main reservoir and dirt collectors P & C reservoir, and time delay reservoir. Check for leaks.

Item 10 Inspect Spare Equipment Box and Seals, Check Detonator Containers & Seals:

Replace if necessary using standard seal, and sealing pliers.

Item 11 Suspension Bearings and Gear Case Oil Level:

Inspect and top up if required. Level in bearings, Max. - to bottom of filling pipe, Min - 1-1/2" below maximum. Quantity between maximum and minimum - 3-1/2 pints. Level in Gear Case, Max. - 2-1/2" from floor of sump, minimum 1-1/2" from floor of sump. Quantity between maximum and minimum - 4 pints. Gauges are provided for checking oil level. Bearings - Red Axle Oil, Stores Item 6482B, Gears - Crater No. 2 M.I. 2631998.

Item 12 Grease Bogie as required:

- (a) Axle box guides.
- (b) Draw bar pins.
- (c) Spring hanger pins, and guides.
- (d) Brake hanger pins.
- (e) Compensating beam pins.
- (f) Brake shaft bearings, with Lithium base grease No. 3 S.I. 5285 EA.

Lubricate buffers, draw bars, brake links, brake beam guides, auto couplers, coupler carrier plates and side bearer plates with graphite grease M.I. 2684500 thinned with lacquer thinners, Item 4348.

Item 13 Compressor Oil Level:

Inspect and top up where necessary. The sump is full when oil level is up to the top of the oil strainer in the filler elbow. SAE.30 S.I. oil, stores item 5255C.

Item 14 Grease Pantographs:

All nipples on the following items must be greased. Pan support mechanism top and bottom frame hinges, equalising links, main ball bearings, main outer spring support pins, push down spring spherical bearings at fixed ends, lever end of push rod, push rod roller, cylinder piston rod guide, piston lubricator on cylinder. (Total nipples : 53 per pantograph), lithium base grease No. 3 Stores Item 5285 EA.

Item 15 Lubricate D.B.V. and I.B.V.

As per Westinghouse instructions.

Item 16 Door catches and hinges:

Check for stiffness of mechanism and lubricate, check alignment and security of locks and striker plates, check clearance with floor as door opens. (SAE.30 S.I., oil Stores Item 5255C).

Item 17 Whistle and Wiper Valves:

Check operation, dismantle and clean if necessary.

Item 18 Bogies:

- Check
- (a) Side bearer clearance - 1/32"
 - (b) Bogie side check clearance.
 - (c) End bearers for condition, inspect under metal dust covers and check oil level.
 - (d) Motor nose brackets and lateral link bolts and pins.
 - (e) Motor gear case bolts for tightness, examine gear case for cracks and condition of lubrication covers.
 - (f) Suspension bearing bolts.
 - (g) Four (4) bolts on auto coupling cover and carrier plates. Gauge auto coupling for shape and height (height - 2'10").
 - (h) Bottom yoke plate.
 - (i) Draw gear rubber (Waughgould gear) check for loose plates and deteriorated rubber.
 - (j) Spring stirrup alignment (must be kept from wearing inside of bogie frame). Misalignment may be caused by excessive wear in axle box guides.

- (k) Coil springs are not broken or compressed.
- (l) Articulating gear pins and beam for wear.

Item 19 Compressor Seals and Flexible Drives:

Check compressor seals for leaking, replace compressor if leak is excessive. Examine flexible drives for wear or deterioration of rubber inserts, replace if necessary.

Item 20 Traction Motor Air Ducts:

Check ducts for splits and broken springs, replace if necessary.

Item 21 Check Hand Brake:

Wind hand brake and check for stiffness, chain linkage is in good condition and releases freely. Lubricate with Red Axle Oil, Stores Item 6482B.

Item 22 Clean Whistle and Windscreen Wiper Valves:

Dismantle valve, check seats and clean.

Item 23 Clean Air Strainers:

Dismantle and clean.

- (a) Compressor suction.
- (b) M.R. Dirt collector.
- (c) Distributing valves (2)
- (d) Time delay reservoir, and P and C reservoir.

Item 24 Check Slack Adjusters:

As per Westinghouse Instructions.

Item 25 Examine Brake Pipe Feed Valves:

As per Westinghouse Instructions.

Item 26 Check P and C Pressure:

70 lb./in² adjusted by reducing valve between M.R. supply and P and C reservoir.

Item 27 Panto Spring Pressure and Operation:

This is measured with a spring balance and should be 22 lb. with new copper or with new carbon strips. Adjustment is made by increasing or decreasing the length of the two main springs (equally both sides).

The time of raising panto should not exceed 20 seconds with a 3 ft. max. lift. This is controlled by the choke under the top nut of the control valve. (Located at the end of the main cylinder).

If the time is exceeded, the orifice in the control valve should be cleaned.

When falling the pantograph should leave the wire quickly to reduce the effect of arcing. At a height of about 6" from the down position cushioning should check the speed of the pantograph.

If cushioning begins too soon the adjustment washer should be replaced by a thicker one, if too late, by a thinner one. (Diagram in 46 class instruction Book Vol. 1 page 50).

Item 28 Panto Hand Pump:

Remove pump from locomotive. Remove cap of non-return valve, examine valve seat and clean valve chamber. Replace valve cap. Remove suction valve cap examine valve and seating, clean with cloth dipped in solvent. Renew seating if worn or hard. Replace valve cap. Remove top cover handle assembly and piston. Clean cylinder and piston and lubricate with lithium base grease No. 3, Stores Item 5285E. Examine piston leather and renew if cracked or perished. Reassemble and test by using pump to raise pantograph.

Item 29 Raise and Lower Valve:

Check that latch tongue and ledge are clean and sharp with no undue wear.

Adjustment

- (1) Push rod should protrude 1/32" below armature plate when latched up. Renew push rod when less than 1/64".
- (2) Manually push horizontal armature fully up and check clearance of 1/64" between the armature edge and the brass latching ledge on vertical armature.
- (3) Manually push the vertical armature to the right and check the clearance of 1/64" between the falling armature and the brass plate. Correct 2 and 3 by packing under the appropriate hinge plate.

Item 30 Flow Indicators:

Check as per Westinghouse Instructions.

Item 31 Compressor Governor:

Clean and adjust to close at 105 lb./in² and open at 120 lb./in².

Compressor Governor Adjustment.

1. Set the higher pressure by adjusting the position of the top cap on the main (large) spring with the two vertical screws (keeping the plate horizontal), lowering the cap to increase the pressure setting.
2. The lower pressure is next set with the toggle spring, increasing the tension of the spring to increase the difference between the settings. As the bearings wear the amount of tension required in the toggle spring for the 15 lb./in² pressure difference will be reduced. This will reduce the tendency for the contacts to "snap" open and closed. When the toggle spring extension from free length is less than 1/16", wear in the mechanism is excessive and the governor is to be returned to Chullora for repair.

Item 32 Control Governor:

Clean contacts and adjust to open at 50 lb./in² and close at 60 lb./in². Check to see that contacts do not re-open as pressure builds up further.

Item 33 Compressor Oil Pump and Filter:

Check compressor oil pump pressure is 35-40 lb./in² during normal running, adjust pressure relief valve if necessary. Remove oil filter element and container from pump, clean container and reassemble with new filter element.

Item 34 Suspension Bearing Bolts: & Wicks.

Tighten bolts with tension wrench set at 200 lb. if torque multiplier is used, 800 ft. lb. on bolt.

Item 35 Compressor Cylinder Heads:

Clean and decarbonise cylinder heads on both compressors.

Item 36 Compressor Valves:

Examine valves, valve disc and springs, renew if badly worn or distorted. The valve lift is non adjustable but the valve should be free to move its full lift which is .083 inch to .093 inch for suction valves and .069" to .078" for delivery valves.

When fitting new suction or delivery valves, check to see that they do not project below the undersurfaces of the cylinder heads and into the cylinders.

For further details see 46 class instruction book Vol. 11, Page 41-42.

Item 37 Brake Cylinders:

Grease leathers with lithium base grease No. 3 Stores Item 5285 EA.

Item 38 Panto 3 Way Cock:

Lower pantographs, remove cap from back of cock, check spring and test that air release hole in cap is free. Remove handle and barrel, clean inside of barrel with cloth dipped in kerosine, dry with clean dry cloth. Lubricate with Lithium base grease No. 3, stores Item 5285 EA. Reassemble and check that cock operates freely.

January, 1972.

DEPARTMENT OF RAILWAYS : NEW SOUTH WALES

46 CLASS ELECTRIC LOCOMOTIVES

ELECTRICAL TRIP INSPECTIONS

Item Numbers correspond to numbers on Master Sheet.

UNIT NO. _____ DEPOT _____ DATE _____

NO.	ITEM	SIGNATURE
1.	Log Book Report	_____
2.	Battery charging current	_____
3.	All lights	_____
4.	Rotating parts	_____
5.	Resistance Blowers	_____
6.	Jumpers	_____
7.	Battery Water Level	_____
8.	High tension compartment	_____
9.	Cab accessories	_____
10.	Spare globes	_____
11.	Speedometers	_____
12.	Vigilance Control	_____
13.	Meters	_____
14.	Jumper Receptacles	_____
15.	Traction Motor Covers & Leads	_____
16.	Traction Motor Air Flow	_____

REMARKS:

SIGNATURE OF SUB-FOREMAN

SIGNATURE OF SUB-FOREMAN

DEPARTMENT OF RAILWAYS : NEW SOUTH WALES.

46 CLASS ELECTRIC LOCOMOTIVES

ELECTRICAL INSPECTION

Item 1 - 16 Trip Inspection	These sheets are the master sheets to
Item 1 - 36 'A' Inspection	be used as a guide for Electrical
Item 1 - 39 'B' Inspection	Trip Inspection and Electrical
Item 1 - 46 'C' Inspection	Inspection Sheet 46 - E1.

ITEM 1:
Log Book Report.

Attend to all work reported by the driver. In the event of repairs not being carried out due to shortage of material etc., carry forward the particular bookings for attention at the next trip inspection. Sign off all bookings relative to the electrical work and remove green sheets from log book, attach sheet to inspection sheets.

ITEM 2:
Battery Charging Current.

Check battery charging current from the ammeter in low tension panel No.2 end. When batteries are fully charged the ammeter should read zero. Should the ammeter show a discharge or excessive charge on arrival at depot, a check of generator voltage should be made and if necessary voltage adjusted using procedure set out in Item 25.

ITEM 3:
All Lights.

Turn on all lights and check for operation. Examine red shades in all marker lights. Check cleanliness of all marker light lenses inside and out.

ITEM 4:
Rotating Parts.

Check all rotating parts for unusual noise, heat or odour. Unusual noise could indicate brush or bearing defects etc. Excessive heat could be the result of overloading. Compare temperature with surrounding equipment. Unusual odour is characteristic with any item of electrical equipment which is overloaded or burnt out.

ITEM 5:
Resistance Blowers.

Check that the resistance fan motor circuit breakers are switched 'on'. There are four (4) of these switches in each cabinet, also check the fan time delay reservoir cock is open. Turn on motor generator sets and test as follows:

1. Turn control switch off and then back on again to trip Z relay, so that power will not be applied.
2. Open accelerating handle to No.1 notch.
3. After one minute the yellow light should be extinguished indicating all resistance fans are running. Check that air is being drawn into each fan.
4. Move accelerating handle either to notch 20 or off, fans should cease blowing after 3 minutes.

If the times are not as above, the fitter should be asked to adjust the governor.

ITEM 6:

Jumpers.

Check condition of jumper head and couplings observing in particular whether any stretch has taken place.

ITEM 7:

Battery Water Level.

Maintain the electrolyte at the correct level. This level has been determined as 1/2" above the splash barrier immediately below the filler cap. Add clean water only. Do not overfill. If it is necessary to add more than 1 quart of water to the whole battery Item 2 should be reconsidered and the charging current checked. If any water is added note date and quantity with chalk inside battery box door.

ITEM 8:

H.T. Compartments.

1. Check motor cut out switch is in the 'all in' position. If motors have been 'cut out' find the fault which caused the motor to be cut out, repair defects and switch to 'all in' position.
2. Test spare fuses.
3. Check that the required high tension fuses are in circuit and fuse spanner is in position.
4. Visually examine E.P. Contactors and arc chutes.
5. Run sequence test step by step to full parallel listening for closing of each contactor.
6. In notch 20 operate wheel slip relay to check contactors open and time delay (where fitted), buzzer and lights.
7. Shut high tension compartment doors.

ITEM 9:

Cab Accessories.

Inspect hot plate and cab heater elements. This equipment will only work when generator is running.

Turn on for as long as possible whilst working on the locomotive to ensure that the circuit breakers will not trip.

ITEM 10:

Spare Globes:

Located in low tension cabinet No.2 end.

Qty.

1	Head light globe	250 watt)
2	Interior light globes	60 watt)
2	Marker light globes	40 watt)
2	Pilot light globes	15 watt)

ITEM 11:

Speedometer:

Check for correct illumination.

ITEM 12:
Vigilance Control.

Test in co-operation with the mechanical staff, to C.M.E. Circular 41/66.

ITEM 13:
Meters.

Failure will usually appear on the log book report.

To test - check that both pantographs are raised, apply brakes and notch up in series and series-parallel. Do not delay in notches.

Approximate currents in Series.										
NOTCH	1	2	3	4	5	6	7	8	9	10
CURRENT	200	350	500	650	750	850	950	1050	1150	overload should trip.

Approximate Currents, in Series-Parallel.				
NOTCH	1	2	3	4
CURRENT	650	720	1000	Overload should trip.

Air brake must be fully applied before attempting this test.

ITEM 14:
Jumper Receptacles.

Examine jumper receptacles for damage to pins, blocks and lids. The pins used on this locomotive are a split pin with an expander in the centre. Rough treatment and faulty insertion of the jumper coupling can result in M.U. short circuits and malfunctions of equipment. Bent pins should be straightened, with care being taken not to break them off. A pin will operate satisfactorily with one quarter missing, but must be replaced if more than one quarter is missing. Examine block for fracture and examine lid for spring tension and ensure retaining dog on the under side of the lid is not broken.

ITEM 15:
Traction Motor Covers and Leads.

Examine all traction motors for condition of top and bottom covers. Ensure that all covers are in position and correctly secured. Check all leads for support, correct any which show signs of rubbing against bogie or motor frames.

ITEM 16:
Traction Motor Air Flow.

With generators running check of air from pinion end of each traction motor. If in your opinion the flow is insufficient bring to the notice of the sub-foreman.

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ITEM 17:
Tests before inspection.

Unknown.

ITEM 18:
Traction Motors (MV.272 and MV.179).

Blow out with clean dry air. Examine commutators, armatures, fields, brushes, shunts and connections. Remove copper and carbon deposits from between commutator bars with stiff brush as required.

Remove dirt and grease from machine frame. Check cover tightness.

<u>Brush Data:</u>	MV.272	MV.179
Grade	EG6749N	?
M.I. Number	?	
Size	2-1/4"x1-3/4"x5/16"	?
Condemn at	1-1/8"	?
Pressure (lbs)	15-1/2	?

ITEM 19:
Motor generators(MG.86, MG.92, ? and ?).

Blow out with clean dry air. Examine commutators, armatures, fields, brushes, shunts and connections. Remove copper and carbon deposits from between commutator bars with stiff brush as required.

Remove dirt and grease from machine frame. Check cover tightness.

<u>Brush Data:</u>	MG.86(mot.& gen.)	MG.92(mot)	MG.92(gen)
Grade	EG.14	EG.14	EG.12M
M.I. Number	?	?	?
Size	1-3/4"x7/8"x1/2"	1-3/4"x7/8"x1/2"	2-3/8"x1-1/4"x1-1/2"
Condemn at	3/4"	3/4"	1-1/4"
Pressure (lbs)	1-3/4 - 2	1-3/4 - 2	6-1/2 - 7

ITEM 20:

Compressor Motors (Types AY.52 and 20 H.P.)

Blow out with clean dry air. Examine commutators, armatures, fields, brushes, shunts and connections. Remove copper and carbon deposits from between commutator bars with stiff brush as required.

Remove dirt and grease from machine frame. Check cover tightness.

<u>Brush Data:</u>	AY.52	20 H.P.
Grade	EG.14	EG 60/3
M.I. Number	0605719	
Size	1-3/4"x7/8"x1/2"	1-5/8"x1"x3/8"
Condemn at	3/4"	1-3/8" (short side)
Pressure (lbs)	1-3/4 - 2	2

ITEM 21:

Resistance Blower Motors (Type DVY.1514B and HEDK 1/5)

Blow out with clean dry air and clean inside machine. Inspect commutator, brush holders, all insulation, connections and give any attention necessary. Wipe over with clean dry rag. Check all covers for tightness.

<u>Brush Data:</u>	DVY.1514B	HEDK 1/5
Grade	Link BO	IM9101
M.I. Number	0606940	
Size	1-1/8"x1/2"x3/8"	1"x1/4"x1/4" approx.
Condemn at	9/16"	1/2"
Pressure (ozs)	6 - 8	

ITEM 22:

Master Controller.

Operate the controller and check for freedom of movement, check the mechanical interlocking mechanism and reverser handle pegs. Wipe all insulation surfaces. Check the contact finger tips for wear and burning. The silver contacts should be renewed before the silver has worn away. Contact gap 1/8".

ITEM 23:

Switches and Push Buttons.

Test operation of push buttons and switches on driver's panel, in H.T. compartments and machinery compartments, check general condition, repair or replace as necessary. Operate panto raise and lower buttons and check operation.

ITEM 24:

Low Tension Panels - In No.1 and No.2 L.T. Cubicles.

Check all connections and equipment. Wipe the panel with a dry cloth and repaint with Berger Hymeg IV.164 enamel where necessary.

ITEM 25:
Voltage Regulator.

Check that all connections are tight and secure, examine carbon contacts for excessive burning, dress or renew as necessary. Draw piece of paper through carbons to remove dirt and grit.

Adjustment.

Allow to warm up on full load.

No Load Voltage.

With the battery contactor open and lights off, measure the voltage between the terminals on the regulator. Adjust control spring to give 118 volts (38 volts for locomotive 7100) - (Increasing the spring tension will increase the voltage).

Full load Voltage.

With the battery contactor closed and lights on, check that the voltage falls under load to 116 volts (or 36-37 volts). If the voltage rises under load, check the connections to both the fixed coil and moving coil.

For further details see 46 class instruction book Volume 1, Pages 89 - 95.

ITEM 26:
Fan Relay Panels.

Check all MCB's and examine electromagnetic relay contacts and connections.

Settings: with relay in the coil energised position, the adjusting screws of the contact fingers should be set to give a contact gap of 1/32". With the relay in the coil de-energised position, the armature adjusting screw should be set to give a gap between the screw and striker board of 0.020".

ITEM 27:
E.P. Switches.

Remove all switch group covers. Manually operate each magnet valve including those on the reverser. Check that magnet valves are holding air both in the 'On' and 'Off' positions and that unit switches are not sluggish in operation but close and open smoothly and quickly. Check that air is not blowing past the pistons and that the reverser operates correctly. If the valve blows in the 'Off' Position the bottom pin valve is not seating and if it blows in the 'On' position the stem valve is faulty. This may be overcome by cleaning the valves. Sluggish or erratic operation may be caused by a dry or tight piston, broken return spring, insufficient pin valve travel or air blowing past the piston. If necessary lubricate piston by inserting the spout of an oil can into the cylinder air release hole and give one squirt of oil (5255C) and check pin valve as in Item 46. Check for broken return spring by using a large screwdriver to lift the piston insulator. If air is blowing past piston change unit switch. Check that cylinder cover gasket does not leak. Clean coil bobbins and terminals with brush and solvent checking flags and heads for security and wipe with dry cloth. Lubricate piston rod, two drops of oil at top of cylinder cover.

(b) Piston Insulators.

Clean piston insulators making sure that the surface is cleaned right around the insulator and paint with Hymeg IV.164 enamel if necessary. Check insulator for any signs of looseness on the spindle.

(c) Contacts, Shunts, Arc Horns.

Check for burnt or worn contact tips and ensure that tips are tight, check contact gap 7/8" min. and contact thickness at 3/4" from heel of contact tip. Renew when worn to half new dimensions. Check that arc horns are in good condition

and secure, change any that are burnt. Check that knuckle pin is in position and is not worn and that there is no sign of high resistance or burnt joints on the blow-out coil connections. Check condition of knuckling spring and that casting is free on spindle. Check for wear on moving contact carrier, casting stop faces and on piston rod guide. Check flexible leads for broken braids and frayed strands, particularly at the mouth of thimbles where braids may break inside thimbles. Change worn, burnt or frayed leads. Check that all connections are tight and that leads do not foul the body of the switch.

(d) Arc Chutes and Barriers.

Remove arc chutes. Examine for deep burns and chipped or broken cheeks. Wipe outside of arc chutes clean. Remove any glazing of the arc plates with emery cloth, replace on unit switches and check that retaining clips are in good condition and that arc chutes are secure.

(e) Insulation.

Clean, the support bars of switches and reverser with solvent and wipe dry with cloth.

(f) Interlocks.

Examine interlock finger contact tips for wear or looseness. Renew interlock finger when all the silver has worn away. Check that fingers are properly secure, connections to the fingers tight and adjust finger pressure (4 - 6 ozs.). Check finger lift $1/8$ " and cam clearance $1/32$ ". For locomotive 7100 finger lift is $1/32$ " for sliding contacts and $1/16$ " for bow type fingers. Contacting thickness is $5/32$ " and $1/16$ " respectively. Lubricate sparingly with 100% absorbed oil. Check finger pressure, 1 - $1\frac{1}{2}$ lbs. and that finger does not touch block.

ITEM 28:

Electromagnetic Contactors H.T. (Type 11 ES).

Remove arc chutes. Check H.T. and L.T. terminals and leads.

Examine contacts, knuckling action and arc chutes, check for free operation by hand. Check alignment of contacts (max. $1/16$ " lateral play) and slack in mechanism.

File contacts if dirty and rough, replace if worn to half original thickness. Both contacts should be replaced. Renew pins if worn.

Set contact gap $7/8$ " - $15/16$ " when open.

Set armature gap $1/16$ " when closed.

Wipe the insulated support bars and repaint with Hymeg IV.164 if necessary.

For diagram of unit see 46 class instruction Book Vol.1, page 66.

Electromagnetic Contactors L.T. (Types 10 ES & 15 ES).

Examine contacts, knuckling action and arc chutes for free operation, Contact face should be bright though rough. If surface is dark and oxidised all over dress with file to normal shape. Renew contacts when worn to half new thickness, both contacts to be renewed. Do not lubricate. Contact gap $3/8$ ". Check terminals and leads for tightness and fraying.

ITEM 29:

Reverser.

(a) Check tension of power fingers (8 - 10lb) and that contact tips are tight and in good condition and finger shunts in good condition. Check that finger hinge is in position, lift finger and check that hinge is free and there is free movement of the finger. Check that finger adjusting nuts are in correct

position (1/16" drop) and springs in good order. Check that contact segments on barrel are secure, and screws tight. Clean up any burns or copper blisters using a smooth file. Clean surface of finger support bar and contact drum with solvent and wipe dry, paying particular attention to the insulation between segments. Wipe contact segments and contact tips clean with solvent soaked cloth and then lubricate with a smear of petroleum jelly (Stores Item 5294). Check all electrical connections are tight.

(b) Reverser Interlocks.

Examine interlock finger contact tips for wear or looseness. Renew interlock finger when all the silver has worn away. Check that fingers are properly secure, connections to the fingers tight and adjust finger pressure (4 - 6 ozs). Check that power contacts are made before the interlock contacts close.

ITEM 30:

(a) Overload Relays.

Check for freedom of operation by working the relays by hand. Examine contacts, replace if silver contacts are worn. Examine power and control terminals for tightness, cracked lugs and frayed wires.

Data.

1. When the relay is in the 'coil energised' position the fingers of the normally open contacts must be vertical and parallel with their supports.
2. When the relay is in the coil 'de-energised' position the contact carrier should be adjusted so that the fingers of the normally closed contacts are vertical and parallel with their supports.
3. Normally closed contacts should have a contact gap of 1/16" when open. When the relay is in the coil 'de-energised' position, the armature adjusting screw should be set so that the striker gaps of the normally closed contacts are greater than 1/32" and the contact gaps greater than 1/16". The striker on the trip element armature should be trimmed so that when the trip element is in fully closed position there is a gap of .020" - .040" between the armature of the reset element and the latch. When the armature of the reset element is fully closed the latch casting should be set and dowelled so that the latch sits square on the catch and there is a gap of .015" - .030". Armature air gap .016" (1/64"). For further details see 46 class instruction book Vol.1, page 76 - 77.

(b) No Current Relay.

Examine contacts for burnt or worn tips, dress as required and renew when half worn through. Examine the flexible copper braid connected to the moving contact, check the armature for freedom of movement.

Check the connections for looseness and for overheating.

Check the knuckling action of the moving contact.

Adjustments:

Knuckle clearance when contacts closed = 1/16" - 3/32"

Contact Gap = 3/16"

(c) Differential Relay.

Check for freedom of movement by working the relay by hand. Examine the contacts. Renew as necessary (silver contacts). Check terminals and leads.

Adjustments:

Armature air gap = 1/4"

Striker gap = 1/16"

Contact gap = 1/16" Min.

(d) Motor Generator and Resistance Fan Relays.

Check for freedom of operation by working the relay by hand. Examine contacts. Check terminals and leads.

Adjustments:

With relay in 'coil energised' position the adjusting screws of the contact fingers should be set to give a contact gap of

1/32" inch for the resistance fan relay
1/16" inch for the Motor Generator relay.

(e) Battery relay:

Examine to ensure freedom of movement, contacts are clean and contact lift is correct. Check terminals and leads.

Adjustments:

Contact tip deflection = 1/4"

Further details of adjustment in 46 class instruction book Vol.1 Pages 96-99.

(f) Auxiliary No Current Relay and H.T. Door Interlock Relay.

Check for freedom of operation by working the relay by hand. Examine the contacts and renew if silver contacts are worn. Check terminals and leads.

Adjustments:

Armature air gap = .016" (1/64")

Contact gap settings as for overload relays.

(g) Wheel Slip Relays.

Examine relay operation and contact condition without removing cover. If necessary clean contact tips with stiff cloth while contacts are closed. Take care not to flex contacts or the relay setting may be altered. Do not lubricate any part of these relays.

Settings:

Contact: pressure 3/4 oz. min., gap 0.030" min.
WSR pick up 33-39 volts, drop out 18-22 volts.
DR time delay - 3 seconds. QR delay - nil.

(Old type relays where fitted are inspected as for fan relays except 30 volt pick up. 1200 ohm coil 1/32" contact gap).

ITEM 31:

Motor Cut-out Switch.

Clean contact fingers and cams and check that fingers make. Check contact finger tips for wear and burning, the silver contacts to be renewed before the silver has worn away. Check detent mechanism and check lubrication of cam faces. Apply a light trace of petroleum jelly (5294) if necessary. Contact gap 1/8" contact pressure 8 ounces.

ITEM 32:

Resistances:

Inspect for signs of overheating, loose connections and damaged porcelains.

Blow out with clean dry air and wipe porcelains with cloth. Check copper red connections on Compressor and supply M.G. resistors.

ITEM 33:
H.T. Door Interlock and Isolation Switches.

1. Operate by hand and check that all moving parts work freely.
2. Examine operation and contacts of main isolating switch and check that blades do not bottom when closed.
3. Clean and lubricate main isolating switch and contacts with petroleum jelly (5294).
4. Test interlock contacts and check that flags and leads are sound and tight.
5. Clean and lubricate pantograph isolating switches.
6. Check clamps and connections of bus bars on roof for heating etc.

Data.

Contact Gap $1/8"$

ITEM 34:
Governors.

Clean and examine contacts on compressor governor, fan time delay, automatic control switch and pressure control switch. Check that terminals are in good order.

Adjustments to be made in co-operation with mechanical staff.

Data.

Contact finger deflection for compressor governor = $1/32"$

Entry of moving into fixed contact = $3/16" - 1/4"$

ITEM 35:
Jumpers.

Clean each jumper head inside and outside with solvent and wipe dry. Check with gauge that heads are not distorted and check that contact block screws are secure. Plug jumper into test rig and check continuity.

ITEM 36:
Batteries.

(a) Maintain water level $1/2"$ over splash barrier. If water has been added since last inspection, record details, erase chalk record, check cells and regulator carefully.

(b) Check and record specific gravity of each pilot cell (should be between 1220 - 1260) if not, advise supervisor.

Clean corroded terminals and coat with petroleum jelly (5294).

Clean batteries and battery box, flush with water.

Check for earth leakage and clean any defective calls.

(c) Discharge Test Using Battery Discharge Tester.

Open the battery switch.

Place the tester probes firmly across each cell in a battery in turn. The individual cell terminals may be flush with the battery top. DO NOT put

the tester across complete battery. Polarity need not be observed. Do not keep the tester on a cell longer than is necessary to obtain a reading.

The meter will indicate as follows:-

- (a) 1.4 to 1.8 volts - fully charged good cell.
- (b) 0.4 to 1.4 volts - discharged good cell.
- (c) less than 0.4 volts, or greater than 0.4 volts but falling rapidly to less than 0.4 volts indicates a dead cell. If a battery contains one or more dead cells, it must be replaced.

ITEM 37:
Traction Motors.

Blow out with clean dry air.

Clean brush arm and Vee ring insulation.

ITEM 38:
Power and Control Connections.

Examine connections for looseness or signs of heating, check that flags and lugs are sound and wires not frayed.

H.T. Compartments

Inductive Shunts
12 motor junction boxes
Underframe earth bar
L.T. terminals boards
(both sides)
Motor out-out switch
Back of cab L.T. panel

Machinery Compartment

Supply MG and transformer terminals
Exciter MG
Both compressor motor terminals
Terminal boards - 2 under floor
- 1 on wall
Exciter field resistances
magnet valves - sand
- fan delay
- pantograph (2)
- regen interlock

Cabs

Main terminal boards
Master controllers
Driver's switch panels
Meters and warning lamps
Sand switch
Regen interlock
Buzzer

Resistance Compartment

Fan terminals
through connectors
Terminal boards for H.T.

ITEM 39:
E.P. Switches and Reverser.

Lubricate. Insert the spout of an oil can into the cylinder air release holes and give one squirt of oil (5255C).

ITEM 40:
Traction Motors.

Check clearance between brush holder and commutator 1/16" - 5/32".

Check brush spring tension.

Check arcing horns and replace studs if necessary to restore 1/2" gap.

Record commutator condition on Feinpruuff chart.

Examine earth brush for freedom and wear:-

Brush Data

Grade	CM1S
MI. Number	0605210
Size	2-1/2" x 2.248d.
Condemn at	1-1/4"
Pressure	15 lb.

ITEM 41:

Motor Generators.

Check brush tensions	Motors	= 2-1/4 lb.
	86 Gen.	= 2-1/4 lb.
	92 Gen.	= 6-1/2 lb.

Check clearance between brush holder and commutator = 1/16" - 5/32".
Clean brush arm and 'Vee' ring insulation.
Record commutator condition on Feinpruuff chart.

ITEM 42:

Compressor Motors.

Check brush tensions = 1-3/4 - 2 lb.
Check clearance between brush holder and commutator = 1/16" - 5/32".
Clean brush arm and 'Vee' ring insulation.
Record commutator condition on Feinpruuff chart.

ITEM 43:

Master Controller.

Lubricate interlocking mechanism on rubbing parts with petroleum jelly (5294).
Check finger pressure = 10 - 14 ozs.
Lubricate finger hinge pins. (oil, stores Item 5255C)

ITEM 44:

Voltage Regulator.

Clean knife edges and blow or brush dust off pole faces.

ITEM 45:

Reversers.

Grease top end bottom main shaft bearings with grease (Lithium base grease No.3 Stores Item 5285 EA).

ITEM 46:

Magnet Valves.

Remove cap from magnet valve and check that coil core is secure.
Clean core and stem valve with solvent. Remove bottom cap, valve spring and pin valve, examine seat, clean and replace. If valve is blowing in OFF grind pin valve with fine emery paste, clean and test.